THE INTELLECTUAL OBSERVER.

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NOTICE TO OUR READERS.

It is now three years since the issue of the first number of the Intellectual Observer, and we may congratulate our readers and ourselves on the success of an experiment that would not have been attempted in any other country, and that would not have been justified by the state of education in England ten years ago. There is no characteristic of the present condition of our society more satisfactory than the rapid, but at the same time steady, growth of a taste for physical and descriptive science. Especially in the direction of natural history (including geology) has this development been manifested; and next in order of popularity, observational astronomy has secured its votaries in hundreds of English homes. For one microscope or telescope that was pointed by the last generation at the minute wonders of earth, or the gigantic marvels of heaven, hundreds are now in daily or nightly work.

During the last three years we have ministered to these pursuits, and we have reason to know that our exertions have been the means of largely extending the number of their followers, and thus creating a still further demand for such information and help as our columns can afford. We have endeavoured to provide for those wants which have been most strongly felt by the growing class of Intellectual Observers but while devoting a large portion of our space to natural history, microscopy, and observational astronomy, we have not omitted to present a many-sided view of the progress of science in all the variety of its departments; so that the six volumes we have issued will be found to contain an exposition of the most striking facts and the most important principles that have been discovered or elucidated since our labours began. Amongst the special subjects of this period which have been discussed in our pages, we may mention the new and important applications of the spectroscope, an instrument of physical analysis, which has not only added to our list of terrestrial substances, as in the discovery of thallium and rubidium, but in

the hands of our distinguished contributor, Mr. Huggins, has given us the most wonderful intelligence concerning the composition of nebulæ and stars. The newest philosophy of geology, the latest application of the mechanical theory of heat, the most interesting researches of the physiologist and the comparative anatomist, the cardinal facts exhibited in recent chemical, electrical, and meteorological investigations, have been placed before our readers without delay. We have likewise published numerous important papers on subjects pertaining to archæology and ancient and modern art.

Having thus briefly reviewed the past, let us consider what, so far as we can see at present, the future demands. During the three years that have elapsed, a large correspondence and many careful inquiries have acquainted us with the fact, that our subscribers desired a selection and treatment of subjects, continually pressing us onward in the direction of expense; we have, indeed, been continually urged to do what could not be expected of any other publication by reason of its cost. The proprietors and the editor gratefully acknowledge that the Intellectual Observer has attained a position, both in this country and beyond its borders, that will justify any outlay necessary for the further development of its plans; but when, as they believe in conformity with the wishes of their supporters, they have made arrangements of a very costly kind for the purpose of increasing the interest and permanent value of this magazine, they feel assured that their subscribers will willingly contribute a small addition of six shillings a-year. The future price of the Intellectual Observer will be Eightcenpence for each part, and it will be so managed as to maintain its character of being the cheapest publication of the kind that has ever been produced.

The plan upon which the Intellectual Observer has been and will be conducted, renders it peculiarly advisable that subscribers should possess complete sets. The publishers will as far as possible endeavour to meet probable demands for back numbers; but some are already nearly exhausted, and others are rapidly following in the same track. They cannot offer to reprint former volumes or single numbers, as the sale of a few hundred copies to complete odd sets would be very far from covering the cost of reproducing the elaborate plates. They would therefore respectfully urge all subscribers to send an early application for any back numbers or volumes, and in future not to reckon upon being able to make up their sets *at any time*, as no more copies will be printed than the publishers have reason to believe will be sold within a moderate period from the date of publication.

The Intellectual Observer will continue to provide

materials adapted to readers in various stages of scientific progress. A portion of each number will be devoted to beginners in various scientific pursuits, and when any reader meets with an article beyond the existing state of his knowledge, he will either find that an elementary paper leading up to it has already been published, or he may expect that one will follow at no distant date. In the selection of topics regard will be had to their novelty, and to their quality as subjects of the day: thus an INTELLECTUAL OBSERVER student will be always up to date; and side by side with matter for novices just entering the portals of knowledge, will be found subjects for the consideration of those who have penetrated the inmost recesses which the human mind has reached.

An additional department has been created for the purpose of affording the earliest explanations of new inventions and discoveries in the applied sciences, and in the practical arts. The information will be conveyed in simple untechnical language, and the record will embrace the principal achievements of human skill in Great Britain, on the Continent of Europe, and in the United States.

In conclusion, we would earnestly advise those who find their first steps in science difficult, not to confine their endeavours to mere reading. Do something, try something, or see something, and half the hardship disappears. It is astonishing how many difficulties in natural history or physiology may be made to vanish if a student will work with a microscope as directed in any of the numerous practical papers we have published. In like manner, a few evenings spent with a telescope under Mr. Webb's instructions, will render many explanatory statements easily intelligible, when without such a proceeding they would remain obscure; a glance through a spectroscope will make a beginner take ten-fold interest in Mr. Huggins' discoveries; and a few chemical experiments will simplify many a statement or illustration that without such aid could convey little to the mind.

Parents may depend upon it that good books and good apparatus are amongst the most remunerative investments they can make. Homes to be happy must be enlightened, and where Intellectual Observers most abound, the wise and beneficent lessons of nature will be most reverently received, and man will form the noblest conceptions of the duty and destiny of a being, situated on a narrow spot of a little revolving globe, limited in faculties, brief in life, and yet divinely endowed with a capacity for evolving thoughts and aspirations grander than all the material powers which condense nebulæ into suns and systems, and which unceasingly arrange and rearrange the particles that build up the fabric of unnumbered worlds.

THE NILE AS A SANATORIUM.

BY F. W. FAIRHOLT, F.S.A.

(*With a Coloured Plate.*)

FACILITIES in travel, more wonderful than the dreams of ancient poets, await the modern voyager; annihilating difficulties of time and circumstance, smoothing his path in the wildest regions, making his journey a mere question of time and money. Nowhere can these facts be more forcibly felt than when travelling on the railway between Alexandria and Cairo. Seated in comfortable carriages of English construction, it is not difficult to imagine oneself on a dusty road, in a hot day, going through Lincolnshire; but a glance through the windows over the flat land of the Delta, shows that we are flying through a primitive land where the very existence of a railway seems an anomaly. Fields of cotton and maize, groups of palms, clusters of mud hovels, some gaily painted, tell of a strange country. Groups of natives in dresses with which we have only been familiar in pictures or on the stage, occupy the road, which runs close by the railway the whole distance. Long lines of lazy-paced camels, or active herds of sharp and useful asses, mix with the rest, giving life and variety to a scene without one European feature in it.

This ease of transit and the constant recommendation of the climate of the Nile by eminent English medical practitioners, as a means of soothing, allaying, or even curing disease, has induced so great an accession of travellers that the country has been much enriched thereby, and places that a quarter of a century since were rigidly barred to the stranger, now gladly open their portals at the bidding of infidel gold. When it is remembered that more than two hundred boats usually ascend the river from Cairo every winter, returning there after three or four months' transit; that these boats are native boats hired at an extravagant rate, chiefly victualled by natives, and include a crew of from fourteen to sixteen men, and that all things are charged to Europeans at nearly double what natives would pay, it may be readily understood that whatever hate to the infidel may warm the heart of the Egyptian true believer, the greed of gain will induce him to keep a placid, smiling countenance.

Still, health when lost is cheaply re-bought at any price. It is the object of this paper to consider this question of the Nile as a watering-place for invalids, and to put before the would-be traveller in search of health a simple statement of facts, that he may be in a fair position to judge for himself if

he be able to bear all the disadvantages, which inevitably accompany the advantages, that present themselves. It must be borne in mind that home medical men are not always the best fitted to decide on an invalid's place of residence abroad. Most doctors are confined to the narrowed sphere of a busy practice, and have generally very shallow and circumscribed ideas of foreign climates, founded on vague reports, or descriptions by enthusiastic travellers, from which no sound conclusions can be drawn. The author of this paper has passed two winters on the Nile, a confirmed invalid, suffering from bronchitis and asthma, and therefore believes himself more competent to speak than any untravelled doctor of London or elsewhere.

But before describing river life on the Nile, it will be well to detail the best mode of getting there. For those who carry much luggage, and object to changes on the route, the simplest and best way is to embark at Southampton, when they will disembark at Alexandria. This, however, involves a long sea voyage across the Bay of Biscay, at a time when storms are usual, and sometimes bad weather from Gibraltar to Malta; the journey occupying altogether about eleven days, the entire voyage being fifteen. Or only a week's sea voyage need be made, going by way of Marseilles to Malta. This involves three long days of railway travelling from London, and all the chances of hotel accommodation, troubles with luggage, etc. Having tried both ways, and being "a good sailor," unaffected by the worst weather, the author comes to the conclusion that nothing can compensate the miseries of a long sea voyage, which is in itself enough to destroy an invalid.

From the beginning of December until the end of March is the only time for the stranger to safely visit Egypt. Before that time he may subject himself to heats which may produce dysentery and ophthalmia; after it he may be met by the *Khamseen* desert wind, which undermines the system, producing lassitude, fever, and death. Consequently the time of year when the voyage must be taken is little likely to ensure a quiet sea.

Arrived in the Bay of Alexandria, transit-boats are provided for passengers who wish to go direct to the railway-station, about a mile distant. Six hours' railway travel, and Cairo is reached; at its port of Boulak native boats are stationed for hire; they are expressly built for the river voyage, drawing not more than two feet of water, as the river in winter is very broad and shallow, and boats are often grounded on the sandy shoals. The native name for these boats is *Dahabeah*; they closely resemble the barges once used by our city companies on the Thames. The saloon is level with the deck; behind it are the

cabins; its roof is covered by an awning, and furnished with sofas, so that the day may be passed agreeably there. When the weather is calm, sailors row; when a breeze arises, the large sail is spread, and the heavy vessel speeds rapidly on. Its form is shown in the engraving, contrasted by the ordinary native boat beside it.

Once afloat, life on the river becomes very monotonous. Cairo is so full of bustle and picturesque beauty that the loneliness of the river a few miles from it is doubly drear. Enthusiasm, and the novelty of the position, has its usual effect for a time; but this wears itself out after days of drifting between high banks of mud, relieved only by clumps of palm trees, squalid villages of earthen huts, and glaring lines of limestone rock. Until Minieh is reached the river is dull and featureless to an extreme degree, and becomes almost insupportably tedious on the return voyage.

About four miles further, and we reach the ruined and half-deserted village of Beni-Hassan. Here are the famous rock-cut sepulchres, covered internally by wall-paintings, made by the ancient Egyptians three thousand years ago. They furnish us with the most vivid delineations of the manners and customs of this people we possess, and are the mine from which our modern books, at home and abroad, have been furnished with their most interesting illustrations. They are now all miserably injured where within reach. Time has spared them, and even native barbarity, that looks unfavourably on such art, has held the hand here; the mischief has been chiefly done by recent European travellers, who delight in writing or scribbling their obscure names on the walls, or breaking away fragments to take home. When we remember that these old works have afforded us our best comments on the truths of Bible history; explaining its allusions and proving its genuine character, as a minute record of past manners; it is sufficient to raise honest indignation at finding Christians thus behaving worse than Turks, particularly when we remember that the Nile journey is an expensive one, and cannot be undertaken by any but those whose education and position should ensure better behaviour.

From Minieh to Siout, the capital of Upper Egypt, the river presents much variety of scene; the rocky chain that bounds the valley of the Nile sometimes closes on the stream in picturesque cliffs, and at other times opens on verdant plains, brilliantly green with abundant vegetation. Siout is charmingly situated; but the traveller may sometimes be long delayed in reaching it, as the river curves continually, and winds are often adverse. He must be prepared to be anchored in a sheltered place occasionally for days together, and bear *ennui* as best he may.

Girgeh is the next town of importance, and here the changes the river has made in its bed are curiously apparent. When Pococke visited it, in the early part of the last century, it was a quarter of a mile from the stream that now yearly washes a portion of the town away. Long lines of buildings, sapped at their muddy foundations, hang ominously over the banks, to fall at the next inundation.

Crocodiles may now be occasionally seen, lying in the sun on sand-banks or low rocks, looking like great slugs, and apparently unconscious of travellers. It is, however, extremely difficult to get near one of them. They crawl lazily into the water as the party approaches within gun-shot distance; to kill them is very difficult, as they have few vulnerable points; if they be wounded, they sink into the river, and go very far away to die. As Nile travelling has increased, so has their caution; they were never bold, except at a sudden advantage.

From Girgeh to Keneh, a distance of sixty-four miles, the river again assumes a tedious monotony. Keneh is a lively town, pleasantly placed amid verdant fields. It is the great gathering-place for pilgrimages to Mecca. Opposite, at a distance of some five miles, stands the half-buried temple of Dendera. The road to it is over rough ground, sometimes partly tangled by coarse desert grass. It is the first important building of ancient date that courts the traveller's attention after the Pyramids are passed. Nothing more perfect exists on the banks of the Nile, or will better reward a visit.

A grand chain of mountains, with outlines of a more picturesque character than usual, bounds the cultivated land on the African side of the river. It is generally about one day's journey from Keneh to Negadeh. This latter place is remarkable as one of the earliest towns where Christians congregated in any number, and where they still live unmolested. A large monastery stands in a garden adjoining the river. About ten years ago it was calculated that this town contained about 3000 Christians, and not more than 500 Mahommedans. A brisk trade is carried on in the manufacture of the coloured cotton wrappers, used like the Scottish plaid by the native inhabitants. The town has the look of a strongly fortified place, from the abundance of tall towers that encircle it; these are, however, very peaceful erections for the breeding of vast flocks of pigeons, bringing an income to its inhabitants. The place altogether is a good specimen of an Egyptian town; it is enclosed by earthen walls, and shut in at night by heavy wooden doors; these open upon narrow lanes, from which others diverge; the whole interior being a labyrinth of gloomy dusty passages, where all kinds of refuse festers in the heat, uncared about. The Orientals are incapable of comprehending

foul smells, and the traveller will find it sometimes necessary to anchor his boat on the windy outskirts of a village or town.

With a fair wind, another day will bring the traveller to Thebes. He will probably be disappointed with the aspect of the world-renowned spot. The Libyan hills are grand features on one side of the stream; but a vast plain stretches towards the Red Sea on the other. The high mud banks on both sides, and the low water in the river, prevents any extended view, hence a sense of flatness or tameness pervades the scene. Luxor, the general landing-place, where all boats anchor, relieves the monotony; it is on high ground, crowned by the ruins of a fine temple. All here is bustle and activity. The bank is lined with travellers' boats, acquaintanceships are renewed, pleasant parties formed for visiting the objects of interest that crowd upon attention here. The natives are busy to obtain employment as guides or attendants, or as salesmen for antiquities of all kinds. Time speeds rapidly away, and a fortnight can never be passed more agreeably than here. The temples of Luxor, Karnac, Gournou, and Medinet-abou; the Colossi on the plains, the wild mountain passes leading to the Tombs of the Kings, all combine to astound the visitor, and give him pleasant memories to dream over in after life. No descriptions and no pictures can convey a complete idea of the wonders of the Theban plain; and when, after days of pleasurable fatigue, the traveller welcomes the repose of evening, it is ushered by sunsets of gorgeous magnificence, the golden light of the sun gives a tinge of green and purple to the blue sky near it, flaky clouds of fantastic form gather around, bearing tints of brightest rose-colour, those nearest the setting sun luminous as himself, so that the eye can scarcely dwell upon these flecks of burnished gold. When the sun has set, an after-glow of rosy light gleams over the entire land for some minutes, with enchanting effect; and the stranger feels, upon his last day on the Nile, that he may never chance to see the sun set again in such supreme glory elsewhere.

With the large majority of travellers the Nile journey ends at Thebes; it is 454 miles distant from Cairo, and the voyage occupies from three weeks to a month, according to wind and weather. Travellers should allow themselves two months and a half for the whole journey and the unavoidable stoppages. It is a slow business at the best of times, nor can Oriental indolence be stimulated.

Should the traveller persevere to the boundaries of Old Egypt at the first cataract, he will be well rewarded by the greater beauty of the river, the vast and wondrously-perfect temple at Edfou, the rock temples and quarries at Silsilis, from whence the ancient Egyptians obtained their building

stones; the grand ruins at Kom-Ombos, and the picturesque town of Assouan. Here he may safely anchor his boat, and ride to the cataract, seeing something of Nubian village-life at Mahatta, where live the men who navigate the boats through the wild and dangerous current of the rock-encumbered river. They are most extortionate in their charges for such service, and demand from £20 to £40 per boat, according to its size; and as they alone have the monopoly of the stream, and are the only persons competent to manage the boats, the traveller is at their mercy.

The Island of Philæ, beyond the cataract, can also be easily visited by a ride across the desert. Its beauty has been celebrated from the earliest recorded time, and has been enthusiastically dwelt on by modern travellers. It is surrounded by rocky scenery of a wild and wondrous kind, as if some gigantic convulsion had piled these vast heaps of granite and basalt, and choked the river.

Fewer still are the voyagers who persevere to Wady Halfeh, that they may visit the rock-cut temple of Abou-Simboul. It is a long and dreary voyage of 837 miles from Philæ, with nothing on the way to equal what the traveller has already seen. The temple is, however, unique in its kind, and very wonderful; the journey must, therefore, be a question of time and expense for each individual to solve before starting.

The price charged per month for the hire of a boat varies according to its size and character, and ranges from £50 to £70. The sailors' wages are low, and are generally computed by the month also; the reis, or captain, receiving about 30*s.*, the sailors half that sum. But these very cheap rates do not truly represent all the traveller pays by a very great deal, inasmuch as gratuities are expected when the boat reaches the larger towns in its course; and the ordinary food of the crew has also to be paid for. A sheep is the usual gift expected, as bread and dried lentils are all the stores laid in for the sailors. A dragoman, or interpreter, is also necessary for the voyage; he generally commands a high salary—about £12 a month, and he takes "black mail" with no niggard hand during the entire journey, first from the natives, and secondly from his employers, so that frequently one-half of the money paid for travelling expenses finds its way into his pocket. It is also necessary to carry a cook and a native servant or two, as assistants or waiters, who generally speak a little English, and charge accordingly.

Should the traveller be an invalid, it is beyond all things necessary for him to remember that he can obtain no medical aid after he leaves Cairo; many English travellers, particularly if they be wealthy, carry a doctor with them, and, to the

honour of the profession be it spoken, that abroad as at home, they never tire in giving their best aid cheerfully to all claimants. Native doctors, if met with in a few of the larger towns, are generally some degrees below the Italian mountebanks who draw teeth and dispense medicines at a country fair. The people, with their inherent fatalism, prefer charms to physic, and have most faith in them.

It must also be borne in mind that though England be stigmatized as a variable climate, the climate of Egypt is more constantly changing. We get at home great changes of wind from different points of the compass; but they usually last for days together, and the difference in temperature throughout the day, or at night, is not very violent. But on the Nile the temperature shifts with every few hours, increasing to mid-day, decreasing to evening, and being freezingly cold in the night; so that the constitution of an European is severely tried when the thermometer may be at 60° at ten in the morning, 100° at noon, and down to 40° in the night. It brings forcibly to mind the words of the patriarch Jacob, when he complained—"By day the drought consumed me, and the frost by night." There is no provision whatever for obtaining fires in the boats, and doors and windows are so constantly warped by the sun that they let in cold draughts on all sides, which can only be guarded against by good coverings. The traveller must in truth be prepared for hot summer days and cold winter nights, and will often find it necessary in the day to change his attire as heat or cold predominates. It is therefore evident that for an invalid to trust implicitly to glowing accounts of Egyptian days, not taking the dark side of the picture in the aspect of Egyptian nights, would be condemning himself to a great risk. Healthy travellers, writing enthusiastically of their experiences, are very blind guides; and doctors who have no travelled experiences whatever are blinder. To some invalids it would be little short of a condemnation to death to send them up the river in draughty boats, without chance of medical aid. The invalid should be well prepared for this; take his own medicine chest, if he cannot take his own doctor, never come on deck before eleven o'clock a.m., or be seen there after sunset, and closely curtain his cabin-windows before going to rest.

The conclusion that the author of this paper arrives at is simply this—that advantage should be taken of the Egyptian day, and the night guarded against. Therefore he is of opinion that a residence in Cairo is preferable to a boat life on the Nile. Cairo has good hotels and resident medical men; full advantage may be taken of the bland climate by day, and comfort be had at night in hotels kept by Europeans. There

is constant amusement in the busy life of the city, while for such as have tastes for historic antiquities, the neighbourhood abounds in sites and objects of the highest interest. If desert winds blow, or the climate generally be too relaxing, the railway will in six hours carry the traveller back to Alexandria, where the cooler sea breezes give the climate the character of Greece or Southern Italy.

Such, then, is a fair estimate of Nile travel. To the invalid it is not the same as to the healthy; the latter will experience no inconvenience where the former may find much. The glorious old river and the solemn reliques of the great men of old that line its banks, deserve all the enthusiastic greetings of the students of antiquity, art, and history. Happy are the days when, floating in the sunshine on its placid bosom, place after place is reached, abounding in wondrous memories; and the homeward-bound traveller bids adieu to the sacred stream, conscious that while life lasts he may call back unrivalled remembrances of scenes, upon which Moses and the father of history have also gazed, with greater wonder, when all that is now ruined was in the glory of its pristine magnificence, under the rule of the ancient Pharaohs, in ages which have long since passed away.

VEGETABLE HYBRIDS AND THEIR PROGENY.

M. Ch. Naudin has recently communicated to the French Academy the results of fresh experiments on vegetable hybrids and their descendants. He states that in 1862 he made numerous crosses, all successful, between *Datura lævis*, *ferox*, *Stramonium*, and *quercifolia*, four well characterized species, between which no intermediaries were known. *Datura lævis* and *ferox*, the two species which differ most in the white series, being mutually fecundated, he reared in 1860 from seeds obtained through this double crossing, sixty specimens of *Datura lævi-ferox*, and seventy of *D. feroci-lævis*. "In this first generation, the whole collection of hybrid individuals having the same origin, however numerous they might be, was as homogeneous and as uniform as could be in a group of any invariable species, or of a pure and sharply characterized race."

"But these 130 hybrids presented a novel fact: they were not only perfectly like each other, but they differed strangely from the two species to which they owed their origin. There was neither the form, the aspect, nor the fruits of the parent species, nor was there anything intermediate between them.

Any one ignorant of their origin must have taken them for a new species." They were all of the violet series, with brown stems, while the parent species had white flowers and green stems.

In 1864, M. Naudin made a fresh sowing of *D. lævi-ferox*, and *feroci-lævis*, and by side of them *D. ferox* and *D. lævis* of pure race. The result was, that thirty-six new specimens of *D. lævis-ferox*, and thirty-nine of *D. feroci-lævis* reproduced the identical characters of the former year, brown stalks, violet flowers, and spinous fruits. He noticed that at the commencement of germination the little stem of *D. ferox* of pure race was purple, so that this colour seen in the hybrid stems was apparently derived from that species. "All these hybrids, though sterile in the first six or seven dichotomies, were fertile in those following. Their seed sown last spring, gave, in the second generation, nineteen specimens of *D. feroci-lævis*, and twenty-six of *lævi-ferox*. The two lots still resembled each other, but by a character the very opposite of that which was most salient in the preceding generation. The great uniformity then remarkable was succeeded by a surprising diversity of patterns; so that out of forty-five plants, composing the two lots, no two could be found that were exactly alike." They differed in all particulars. One lot, however, of *lævi-ferox* went back to the type of *D. lævis*, except that the lower part of the stem was purple. In very few was a slight resemblance to *D. ferox* noticeable, most being more like *D. Stramonium* and *D. quercifolium*. "Some had white flowers and green stems, either all green, or with purple at the base; others had violet flowers of different tones, and stems more or less brown; sometimes even purple, passing into black, as in *D. tatula*, which is the most perfect type of the violet series. The fruits were of all sizes, from a filbert to a large nut; and of these fruits some were very spinous, others only covered with tubercles, or nearly destitute of spines. Some individuals fructified in the first dichotomy, others only in the last, and some produced no fruit at all. In fine, the forty-four plants, constituting these two lots, were all individual varieties, as if the tie binding them to specific types were broken, and their growth had run wild in all directions."

M. Naudin then mentions a case of hybrid Marvel of Peru, in which the second generation differed both from the parents and from the first.

In 1863 and 1864, he watched the sixth and seventh generation of a hybrid *Linaria purpureo-vulgaris* which he had kept for many years. A good many went back, some completely, some partially, to the *L. vulgaris*, with yellow flowers, and a smaller number to *L. purpurea*, with purple flowers. The

major part inclined to neither species, nor did any resemble the first hybrid generation, but presented all kinds of variation.

M. Naudin then refers to hybrid petunias, which, he says, though common in gardens, have not received the attention due to them from scientific men. He says that *P. nyctaginiflora*, which has white flowers, and *P. violacea*, with violet, cross with facility, producing hybrids as fertile as themselves. In the first generation all the hybrids resemble each other; but in the second they became diversified in a surprising manner, some becoming white, some purple; while others, and they constitute a large residue, exhibit all tints between the two. If a third generation is raised by artificially fecundating the second, still greater variations occur, and if the process is continued monstrosities are obtained, which fashion decides to be perfection.

Similar facts occur with primulas, roses, apple-trees, pears, etc. The question then arises, "but if these crossings have produced such phenomena of irregular variability in cultivated plants, is it not possible that the same cause has occasioned their appearance amongst wild plants? We are led to think so when we cast our eyes on certain generic groups, such as sallows, potentillas, briars, etc., in which those species which at first seem the best characterized, are united by so many intermediate forms, that we do not know where to place the limits of such species. This supposition is the more probable, because the species in question are so situated as to render their crossing likely to occur." M. Naudin then makes certain observations on the variations which different species exhibit without any crossing with another species or race. He considers that with hybrids the tendency is towards individual variation without fixity, while with pure races variations tend to become constant, and if not interfered with, give rise to fresh races homogeneous and enduring.

Many of our subscribers will have opportunities of making experiments similar to those of M. Naudin, and they may be reminded that both naturalists and physiologists anxiously look for additions to this class of facts.

THE AUSTRALIAN LYRE BIRD.

BY "AN OLD BUSHMAN."

The Lyre Bird, or native pheasant of Australia, *Menura superba* of naturalists, called Bulla bulla by the natives, from the peculiar monotonous call-note of the female, is, as far as body plumage goes, a very plain, dull-coloured bird, about the size of the common English pheasant; but its singular beauty consists in a long, beautiful, lyre-shaped tail of sixteen feathers, with the peculiar form of which most of your readers are, doubtless, acquainted. According to Mr. Gould, the stronghold of the lyre bird is in the colony of New South Wales; but to my certain knowledge it is, or at least was, a few years since, common in most of the ranges and gullies extending eastwards from the Bass River to the Tarra in Gipps' Land, and also in the gullies on the Plenty, Dandenong, and Gipps' Land ranges. It is from the personal observations of myself and a friend, now stationed in this district for the purpose of collecting, that the following notes are compiled:—

Of the numbers of those who at one time or another must have seen and admired its fibrous and lyre-shaped tail, but few were perhaps aware of the fact that the light and fairy-like structure before them was the elegant appendage of a bird whose powers as a ventriloquist and imitator of sounds appear to be illimitable. To be able to form a fair estimate, however, of their extraordinary abilities in this respect, one must be on the pheasant ground by earliest dawn on any fine morning during the months of June, July, and August, this being their breeding season, during which they are most noisy. Now this is not quite so easy as might at first appear, since what the bushmen call their "whistling heaps"—little circular mounds of scratched-up earth in the centre of a mass of ferns, or sword grass—are generally located in the thickest part of a dense musk scrub, or by the sides or at the bottom of a deep fern-tree gully, whose cloistral shades, like true recluses, they greatly affect. To pierce such solitudes as these before the sun has risen, struggling up to the waist through a thick undergrowth of grass and fern, saturated with everlasting dew, at the imminent risk of breaking either neck or shins in stumbling over some of the numberless fallen logs that intercept your path, and where every step you take necessarily brings you into collision with an overhanging bough which discharges a copious shower-bath over your head and shoulders, is, to say the least of it, not pleasant, and not likely often to be attempted by any one, save those actually in pursuit of the bird itself.

A previous night's camp near the spot would, in most cases, bring a man into the vicinity of the birds sufficiently early for his purpose of watching them at play. The first intimation of this would probably be a rather loud, though melodious warble, from some old cock on a neighbouring tree, for he generally salutes the rising sun from his roosting place. With its earliest ray, however, he descends from his perch, and you will then hear the monotonous "bulla bulla" of the hen bird as she calls to her mate, and together they go scratching about the bush for their breakfast. Soon an old cock will scratch his way to one of these mounds, which are, doubtless, feeding places as well as arenas for their morning concerts, and then, with a running fire of his own sweet notes, which he keeps up throughout the whole performance, the fun begins. Now, if you are clever enough to creep within good earshot of that little magic circle without disturbing the bird, you will find that from thence proceed in rotation the note of nearly every bird indigenous to the scrubs. First, perhaps, you will hear, not one, but a whole mob of King parrots, or lories, in full corroboree, the noise of their wings in flight being at the same moment imitated with the greatest exactness; then probably comes the smack of the whip bird, then the harsh cry of the black cockatoo, together with the grating sound he makes with his bill in excoriating the bark of the tree in search after grubs. All this, together with many another cry of bird or beast, even to the howling of the wild dog, I have heard proceed from one and the same lyre bird in a very short space of time. Should there be wood cutting, or any other extraneous noise going on in his neighbourhood, he quickly makes himself master of the sound, and adds it to his budget. I have frequently heard the beating of the blacks' corroboree sticks imitated to perfection. This the blacks themselves maintain is done with the tail of the bird. During the greater part of the time that the bird is thus engaged the tail is spread out, peacock fashion, at right angles, but sometimes laid so low as to form a very acute angle with his back, the bird himself slowly revolving on his little orbit, and every now and then regarding his fairy appendage with looks of gratified vanity. It is only while thus occupied that he can be approached with any chance of success. In such situations, however, he falls an easy prey to the noiseless and panther-like approach of the blackfellow; but the attempt of the white man is generally foiled, either by the brightness of his apparel or his over anxiety to reach his quarry, which induces him to move when the bird is not in full song—a fatal error, quickly made known to him by a serpent-like hiss, which tells in a language plainer than words that his presence is detected. It must not,

however, be inferred from the above that the cock bird is the sole performer; the hen will also both whistle and mock the notes of other birds, but she does it in a more desultory manner, never remaining long in one spot.

These birds sometimes vary their entertainment with the most amusing capers. A friend of mine once having followed a pheasant to its roosting place, which in this instance was a tall gum tree in a tolerably open situation, determined to be near the spot by daybreak, in order to watch his manœuvres, and, if possible, obtain the bird. Accordingly, before break of day, he posted himself near the tree, and soon after had the satisfaction of seeing the bird descend from it, and at once commence scratching and feeding on the ground below it. This bird was evidently in a merry humour, for nearly every log he came across he mounted, made three or four pirouttes on the top of it, and then on again, until he came to a full stop, when, after mocking the whip bird, the laughing jackass, and one or two others, he suddenly began revolving in a circle, the diameter of which was scarcely greater than the length of his own body, at such an amazing rate that it was impossible to see his feet touch the ground. A charge of No. 4 shot, however, cut him short in the middle of his gyrations, and he proved to be a cock with what the bushmen call a half tail, *i.e.*, half plain, half fibrous. The tail feathers, at first wholly plain, always commence shredding out backwards from their extremities to their springing, till they become wholly fibrous. I have heard that in the case of very old birds the tail sprouts fibrous like the pheasant wren, but I never met with an instance of this myself. The Gipps' Land blacks believe that the hens after a certain period get fibrous tails like the old cocks, but if this is true, it must be after they have done breeding. The dome-shaped nest and chocolate-coloured egg (they lay but one) is generally placed either in the embankment of a deep creek or gully, or else well hidden in the midst of the branches, where they spring from the stem of one of a group of fern trees. Where these trees grow thick, and their branches interlace, their resemblance to a mediæval crypt or cloister is most striking, save, perhaps, that the cone-fretted stem of the fern tree has rather a Moorish than a Christian look about it; and the thought has often struck me while wandering under the melancholy boughs of these splendid Filices, how astonished the Old World builders would have been could they have been told that in the recesses of a country to them unknown, there grew in wild luxuriance the living counterpart of their own stone and mortar erections. I will just mention one fact with regard to the nest which shows the extreme cunning of these birds, viz., that it is almost always covered with a coating of

living moss, which literally grows over it, and so amalgamates it with surrounding objects, that were it not for the suspicious little hole at the top it would be impossible to discover it.

Before concluding these remarks, I feel bound to bear testimony to a pleasing trait in the economy of these birds, which is the remarkable solicitude of the female for her young one. Although at all other seasons she is, *par excellence*, the bird in which the *noli me tangere* principle is most strictly developed, yet during the period that her offspring is a helpless nestling, she so far overcomes her natural timidity in anxiety for its safety, that if you touch the young bird, causing it to make a plaintive cry, and the mother is within hearing (which is generally the case), she will come through the bush like a flash of light, and, seeing the formidable appearance of the disturber of her home, will commence rushing about in gradually contracting circles, evidently in the greatest distress. In marked contrast to this, however, is the conduct of the male bird, who, after the period of incubation is over, never goes near the nest, or appears to care a pin what becomes of his family.

As civilization gradually increases, many birds and animals are becoming so scarce or altogether extinct, that in a very few generations after this they will be known only by name, or as matters of history. Witness the kangaroo, the emu, and even the native pheasant, and some others in this very land. It is, therefore, a matter of considerable surprise to me that no systematic efforts are made to rear and domesticate many a bird and animal which is every year becoming scarcer, and which would doubtless thrive under the fostering care of man. I have known this tried in regard to the very bird of which we are now treating; but the few schoolboy attempts which I have witnessed never can and never will succeed. A friend of mine, who has now studied the habits of the lyre bird in a state of nature for many years, and who in one season obtained in Gipps' Land no fewer than 114 tails with his own gun, has written to me a plan by which he feels confident that he could rear them, and I think his system a likely one, but it would entail great expense and loss of time; and to the poor bushman, whose time is money, and whose sole dependence for subsistence is his gun, the advantages of success in undertakings of this nature are not at all commensurate with the certain loss in case of failure. "Should this noble bird, however"—thus he concludes his letter to me—"be domesticated, and I feel certain that this day will come, and he should retain in captivity those admirable powers of mimicry which he daily exhibits in the recesses of his native forests, universal consent would, I have no doubt, acknowledge his right to the title of the 'King of Mocking Birds.'"

THE BRITISH OCEANIC ENTOMOSTRACA.

BY GEORGE S. BRADY, M.R.C.S.,

Secretary to the Tyneside Naturalists' Field Club.

(With a Coloured Plate.)

Under the term "Oceanic Entomostraca" we include all those free-swimming species which are met with not far from the surface of the sea, either in littoral situations or in the open sea far away from land. We do *not* here take cognizance of those which haunt the sea bed and find their sustenance by crawling over weeds and rocks, their powers of swimming being either altogether wanting, or so slight as to serve only for very short excursions from the ground.

The species to which our present paper refers are met with during the warm months of summer in wonderful abundance near the surface; so numerous, indeed, are they that they constitute the chief food of very many fishes, and they may often be plainly seen to impart a turbid or specky appearance to the water. They are best taken by means of the towing-net, an appliance which, for the benefit of those who are not acquainted with it, we may briefly describe. It consists of a long funnel-shaped net of bunting, crinoline, or some other strong but loose-meshed material, attached to a ring of cane, eighteen inches or more in diameter. It is well to weight the ring moderately at one side, so as to sink it a little beneath the surface of the water. But besides the outer net above described, there should be an inner net made of the same material, of the same diameter, but only of half the length, and tapering more rapidly. This is to be left open, with an aperture of about a couple of inches at its narrow end, and is intended to act as a valve to prevent the regurgitation of the contents of the outer net when being dragged through the water. The apparatus will be more convenient if the outer net, instead of being sewed up close at the small end, be left with an open neck, to which a cupping glass or a strong glass bottle may be attached by a piece of string or elastic. The bottle thus attached will receive the contents of the net, which may be removed much more readily and with less injury than by turning a net inside out, which must be done if not provided with this arrangement. Three or four strings are to be attached at equal distances round the ring of the net, tied together at their free ends, and finally secured to a long and strong cord, by which the net is

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Anomalocera Patersonii, &c.

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dragged through the water at the stern of a boat. It will often be found to collect (besides the small crustacea) great quantities of medusæ, free-swimming annelids, and larvæ of many kinds. These (except the medusæ, for which no good preservative fluid is yet known) may be put into spirit, and thus kept for examination.

Setting aside any special interest which these entomostraca may possess for those who give particular attention to them, there are some points in their structure and physiology which are exceedingly curious, and which cannot fail to interest any "intellectual observer." These are connected chiefly with sexual differences. In the family *Harpactidæ* the males possess, for the most part, a large vesicular swelling on the upper antenna (see Fig. 1); while in the female the antenna is more slender, and destitute of this appendage. In the *Pontellidæ* and many of the *Calanidæ* the right antenna of the male is provided with a hinge-joint near the middle, for the purpose of clasping; and above and below the hinge there is a serrated plate which serves to render the grasp more secure. The left antenna of the male, and both those of the female, are destitute of the hinge. In the *Pontellidæ* there is likewise large pyriform swelling near the middle of the male antenna. This, with serrated plates and hinge, is well shown in the coloured plate of *Anomalocera Patersonii*. In the two last-mentioned families, the fifth pairs of feet offer also remarkable sexual differences, and afford excellent specific characters; these, however, are so varied, that drawings of each species would be required to elucidate them. The right fifth foot of *Ichthyophorba denticornis* is shown at Fig. 4. The curious method of impregnation which obtains amongst the Copepoda has already been mentioned in the pages of the INTELLECTUAL OBSERVER. It consists in the attachment to the abdomen of the female of elongated cells termed "spermatophores" or "spermatic tubes." These may often be seen before their emergence from the body of the male. Fig. 5 exhibits a bundle of them attached to the abdomen of the female *Temora velox*.

The oceanic species with which we are concerned in this paper, belong to two distinct orders, Cladocera and Copepoda, both of which are well represented in all our fresh-water ponds, the first by the common *Daphniæ*, the second by the still more common genus *Cyclops*.

Dr. Baird, in his excellent *Natural History of the British Entomostraca*, published by the Ray Society in 1849, describes ten marine species of these two orders:—*Evadne Nordmanni*, Lovèn; *Canthocamptus Stromii*, Baird; *C. furcatus*, Baird; *C. minuticornis*, Müller; *Harpacticus chelifer*,

Müller; *H. nobilis*, Baird; *Alteutha depressa*, Baird; *Temora Finmarchica*, Gunner; *Anomalocera Patersonii*, Templeton; *Cetochilus septentrionalis*, Goodsir. An eleventh species (*Notodelphys ascidicola*, Allman) is also provisionally included by Dr. Baird amongst the Copepoda, but this little parasite is now classed with the fish lice in the order Pœcilopoda.

More recently eight additional species have been described by Mr. Lubbock in the *Annals and Magazine of Natural History* (second series, vol. xx.) Of these, however, three are probably referable to previously published species, and one (*Monstrilla anglica*) is imperfectly known, and may very likely be found to belong to the order Pœcilopoda.

If to these we add *Peltidium purpureum*, Philippi, and *Hersilia apodiformis*, Philippi (two species first recognized as British by Mr. Spence Bate), a few others noticed by myself in Reports presented to the British Association and to the Tyneside Naturalists' Field Club, in 1863; lastly, eight species recorded for the first time in this paper, we shall have, I think, a complete list of all the known British marine species belonging to the two orders Cladocera and Copepoda.

To facilitate reference, I insert first a classified list of the British species, as far as our present knowledge extends, proceeding afterwards to notice more in detail those which are new to our fauna.

Order CLADOCERA.

Fam. POLYPHEMIDÆ.

Evadne Nordmanni, *Lovèn.*
„ polyphœmoides, *Leuckart.*

Order COPEPODA.

Fam. HARPACTIDÆ.

Tachidius brevicornis, *Müller.*
Tisbe furcata, *Baird.*
Westwoodia nobilis, *Baird.*
Dactylopus Stromii, *Baird.*
„ tisboides, *Claus.*
Thalestris longimana, *Claus.*
Harpacticus chelifer, *Müller.*

Fam. PELTIDIDÆ.

Peltidium purpureum, *Philippi.*
(? Oniscidium, *Claus.*)
Hersilia apodiformis, *Philippi.*
Alteutha depressa, *Baird.*
„ bopyroides, *Claus.*
Zaus spinosus, *Claus.*
„ ovalis, *Goodsir.*

Fam. CORYCÆIDÆ.

Monstrilla anglica, *Lubbock.*
Corycæus anglicus, *Lubbock.*

Fam. CALANIDÆ.

Cetochilus septentrionalis, *Goodsir.*
Calanus anglicus, *Lubbock.*
„ Clausii, *Brady.*
Dias longiremis, *Liljeborg.*
Temora Finmarchica, *Gunner.*
„ velox, *Liljeborg.*
Ichthyophorba denticornis, *Claus.*
„ hamata, *Liljeborg.*

Fam. PONTELLIDÆ.

Anomalocera Patersonii, *Templeton.*
Pontella brevicornis, *Lubbock.*
„ Wollastoni, *Lubbock.*

EVADNE NORDMANNI, Lovèn. Baird, *British Entom.*, p. 114, plate xvii., fig. 2.

This species occurs in considerable numbers, in the warm months of summer and autumn, on the east coast of Britain. I have taken it plentifully off the Durham coast, and have noticed it also in gatherings from the Shetlands, given to me by the Rev. Alfred Merle Norman. Mr. Goodsir took it in the Frith of Forth. It will probably be found to exist in all the British seas.

EVADNE POLYPHEMOIDES, Leuckart. Leuckart, *Weigmann's Archiv.*, 1859, p. 262.

First noticed at Nice by Leuckart, and described by him in *Weigmann's Archiv.*, which description is translated into the *Annals and Magazine of Natural History* (third series, vol. v., p. 445). It is of pretty frequent occurrence off the Durham and Northumberland coasts, and also in the Shetland gatherings mentioned above. The general appearance of the order Cladocera, to which these two Daphnians belong, will be understood by a reference to the figure of *Daphnia rotunda*, given in the INTELLECTUAL OBSERVER, vol. i., p. 448. The two species of Evadne here noticed are sufficiently distinct. *E. Nordmanni* has mostly a red tint, a large carapace, empty except when bearing ova, and tapering to a sharp point inferiorly, so as to give the animal a triangular outline. *E. polyphemoides* is smaller, has a very large spherical head separated from the body by a strongly marked neck; the carapace is very much rounded posteriorly and inferiorly, and has a straight anterior margin rounded at the antero-inferior angle. The abdomen projects anteriorly, and terminates in two strong spines directed downwards, thus giving the animal an appearance not unlike that of *Daphnia mucronata*.

TACHIDIUS BREVICORNIS, Liljeborg. Lilj, *Crust. ex. ord. tribus*, t. xxii., figs. 12—16; t. xxiii., figs. 1, 2, 9; t. xxvi., figs. 17, 18.

An entomostracan, referable apparently to this species, I have taken in a salt marsh on the river Wear, near Sunderland. The drawings, made with great care from my specimens, differ in at least one important particular from those of Professor Liljeborg, but from the extreme minuteness of the animal, and consequent difficulty of dissection, it is quite possible that I may have made some mistakes, and having been unable recently to find fresh specimens for further examination, I prefer rather to adopt this supposition than to describe my capture as a new species. It is probable that *T. brevicornis* may be identical with *Canthocamptus minuticornis*, Baird; but Dr. Baird's figures and descriptions are insufficient to enable us to settle that point satisfactorily. The principal diagnostic

character of the genus is found in the structure of the swimming feet, the first four pairs of which are alike, each foot consisting of two tri-articulated branches. The first antenna of the male bears a remarkably large vesiculiform swelling, a character not uncommon in this family, but nowhere better developed than in *Tachidius*. The antenna is beset also with long setæ of very diverse form and structure, the uses of which, as well as of the vesiculiform swelling, are very imperfectly, if at all, understood. The antenna is represented at Fig. 1.

Tisbe furcata, Baird. *Canthocamptus furcatus*, Baird. *Brit. Ent.*, p. 210, plate xxv., figs. 1, 2; plate xxx., figs. 4—6.

A species of very common occurrence in littoral situations, and which has been described and figured elaborately by Baird, Liljeborg, and Claus. A peculiar parasite of polypoid form is noticed both by Baird and Claus as frequently infesting this species.

Westwoodia nobilis, Baird. *Arpacticus nobilis*, Baird. *Brit. Ent.*, p. 214, plate xxviii., fig. 2, *a—e*.

I do not know this species. Berwick Bay, Dover, and the North Foreland are given as habitats by Dr. Baird.

Dactylopus Stromii, Baird. *Canthocamptus Stromii*, Baird. *Brit. Ent.*, p. 208, plate xxvii., figs. 3, 3*a*.

This pretty little creature seems to be of somewhat rare occurrence. I have taken it in rock pools on the Durham coast, and on the Isle of Man, but have seen no examples of it from other places. The localities given by Dr. Baird are all on the east coast, ranging from Berwickshire to Dover.

Dactylopus tisboides, Claus. Claus, *Die frei lebenden Copepoden*, p. 127, t. xvi., figs. 24—28.

A species which I had been accustomed to refer to *Harpacticus chelifer*, I have now little hesitation in recording as *D. tisboides*, Claus; though I am unable to state with certainty to which of the two species the figures and descriptions of Dr. Baird and Liljeborg refer. Probably they were taken indiscriminately from both species. Be this as it may, the form which I refer to *D. tisboides* is, so far as my observations extend, by far the more common of the two. I have taken it abundantly on the coasts of Northumberland and Durham, and in the Isle of Man, and it forms the bulk of one of Mr. Norman's Shetland gatherings. The characters by which it may most easily be distinguished from *Harpacticus chelifer* are (1) the form of the male antenna, which exhibits a large vesicular swelling similar to that of *Tachidius brevicornis*; (2), the first foot, which, besides minor differences, has, about the middle of the small inner branch, a long plumose bristle reaching nearly to the extremity of the ramus; and (3) the shape of the lower foot-jaw, which is a simple, somewhat oval, clawed

hand, bearing a single long bristle on the centre of its inner, slightly serrated edge.

THALESTRIS LONGIMANA, Claus. Claus, *Die frei lebenden Copepoden*, p. 130, t. xviii., figs. 1—11.

The genera *Thalestris* and *Dactylopus* are closely allied to *Canthocamptus*, from which they have been separated by Dr. Claus, in his recently published work on the Copepoda of Germany, the North Sea, and the Mediterranean. The following are the more important characters of the genus *Thalestris*. Lower foot-jaw armed with a strong prehensile hand; superior antennæ mostly with nine articulations; branches of the first pair of feet much elongated, prehensile; posterior feet of the female leaf-shaped, covering the ovisac. *T. longimana* is a fine species, richly coloured with deep brown and red. Its most remarkable feature is the largely developed chelate lower foot-jaw, which forms a very formidable and effective grasping apparatus. This is shown at Fig. 2. The first feet are very much elongated, and armed with long slender claws which, from their position, must be admirably adapted to co-operate with the antennæ and foot-jaws in the work of seizing and securing prey. The only British locality known to me for this species is Sunderland, where I have taken it in shallow tidal pools.

HARPACTICUS CHELIFER, Müller. Claus, *Copepoden*, p. 133, t. xix., figs. 12—20.

The species which I have usually considered to come under this designation is, as stated above, *Dactylopus tisboides*. The only examples I have hitherto seen of the true *H. chelifer*, are a few taken near Sunderland a year or two ago.

PELTIDIUM PURPUREUM, Philippi. White, *Pop. Hist. Brit. Crust.*, p. 308, plate xviii., fig. 4.

The family *Peltididæ*, of which this species is the type, is very different in general appearance from the *Harpactidæ*, being much broader and flatter, and less adapted for active movement in the water. They may often be met with on the fronds of Fuci and Laminariæ in tide pools, but some of them are taken by the towing net in the open sea.

Of this species, I have seen only one specimen taken in a tide pool near Sunderland. Mr. Spence Bate has taken it on the south coast of England.

HERSILIA APODIFORMIS, Philippi. White, *Pop. Hist. Brit. Crust.*, p. 308.

I know nothing of this, except from the description referred to above. It has been taken in Britain only by Mr. Spence Bate.

ALTEUTHA DEPRESSA, Baird. Baird, *Brit. Entom.*, p. 216, plate xxx., figs. 1, 2, *a*, *b*.

Whether this be referable to the following species I cannot determine, not having seen authentic specimens of it. The only habitat given by Dr. Baird is Berwick Bay, where, he says, it is not common. It is to be hoped that *A. depressa* may again be captured, in order that its relation to the following species may be definitely made out.

ALTEUTHA BOPYROIDES, Claus. Claus, *Copepoden*, p. 143, t. xxii., figs. 10—17.

This species agrees in most of its characters with *A. depressa*, as described and figured in Dr. Baird's work; but the details of structure there given are not sufficient to allow of certainty in the matter. My specimens were taken in the towing net, three or four miles off the Durham coast.

ZAUS SPINOSUS, Claus. Claus, *Copepoden*, p. 146, t. xxii., fig. 25; t. xxiii., figs. 1—10.

The genus *Zaus* is nearly allied to *Alteutha*, from which it is separated by having both (instead of only the outer) branches of the first pair of feet armed with terminal claws, and also by the greater breadth of the rudimentary fifth feet.

I have a few specimens of *Z. spinosus* taken in tide-pools at Roker near Sunderland.

ZAUS OVALIS, Goodsir. Claus, *Copepoden*, p. 146, t. xxii., fig. 18; t. xxiii. figs. 11—18.

A much larger species than the foregoing. It is very much more elongated, has comparatively short tail setæ, and a different shell structure. I am indebted to C. Spence Bate, Esq., for specimens recently taken at Banff. I am not aware that it has previously been noticed on our shores. It was originally described by Mr. Goodsir in the *Annals of Natural History* for 1845.

MONSTRILLA ANGLICA, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

CORYCÆUS ANGLICUS, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

The descriptions given by Mr. Lubbock (*loc. cit.*) are our only authority for the existence of these two species. They do not appear to have been found by any other observer, and the characters given by their discoverer would lead us to suppose them referable to the Pœcilopoda or fish parasites.

CETOCHILUS SEPTENTRIONALIS, Goodsir. Baird, *Brit. Entom.*, p. 235, plate xxix., figs. *a*—*g*.

Dr. Claus has divided this into two species, *C. longiremis* and *C. Helgolandicus*, and being unable to determine to which of these two forms Goodsir's description was meant to apply, has dropped the original specific name altogether. This is to be regretted, as it is almost impossible that, in the early

days of the investigation of any particular group, the minute specific characters should be understood, or, indeed (in many cases), that the really important characters should be recognized as such. Under these circumstances it seems unfair that the names proposed by the first describer should be allowed to lapse, merely because their descriptions are not found to be minute enough for the purposes of more modern science. Where two or three forms, massed together by the original discoverers under one specific designation, afterwards prove distinct enough to require separation, any author describing them would do better to fix the original name upon one of these forms, even though doubtful as to the first reference, than to ignore the labours of a previous investigator by discarding his nomenclature altogether.

C. septentrionalis, as met with in our seas, agrees entirely with the characters ascribed by Dr. Claus to his *C. Helgolandicus*. I can, therefore, entertain no doubt that Goodsir's specific name is properly referable to that form, and have here retained it on the ground of priority. The characters which distinguish it from Dr. Claus's *C. longiremis* appear in the arrangement of the long setæ of the upper antennæ (Fig. 3), and in the presence of a row of serrations on the inner side of the basal joints of the fifth pair of feet. It haunts, indifferently, both the open sea and tidal-pools, and is often to be met with in countless numbers, appearing to be pretty generally distributed in our seas. I have specimens of it from Shetland, Northumberland, and Durham, and the Channel Islands.

Calanus anglicus, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

Unknown to me, except from Mr. Lubbock's account of it.

Calanus Clausii, Brady.

A new species, described by me in a report presented to the Tyneside Naturalists' Field Club, but not yet printed. The fifth feet of the male are long and straight, slender, and composed of simple cylindrical articulations, the last of which tapers to a fine point. The first joint of the abdomen is, in the female, very tumid anteriorly. I have found *C. Clausii* abundantly in gatherings of entomostraca from Shetland, the Channel Islands, and the coast of Durham, where it abounds both in tide-pools and in the open sea.

Dias longiremis, Liljeborg. Liljeborg, *Crust. ex. ord. tribus*, t. xxiv., figs. 1—13.

This species is readily recognized by the knotted appearance and peculiar arrangement of the setæ on the upper antennæ, and by the characters of the fifth feet, which, with their uncouth and gouty-looking conformation, are not easily described except with the aid of figures, for which we have

not space. It is identical with Mr. Lubbock's *Calanus Euchæta*. I have found it in the Channel Islands, Isle of Man, and Durham coast.

Temora Finmarchica, Gunner. Claus, *Copepoden*, p. 195, t. xxxiv., figs. 1—11.

There seems to me to be no doubt that this is the species described by Mr. Lubbock (*loc. cit.*) under the name of *Diaptomus longicaudatus*. It is, without exception, the most abundant of the British Marine Copepods, at all events in littoral situations, where, during the latter part of summer, it often occurs in such swarms as to form quite a consistent mass when taken up in the net. Shetland, Durham, and the Channel Islands have all afforded me this species in great numbers.

Temora velox, Liljeborg. Lilj. *Crust. ex. ord. tribus*, t. xix. figs. 9, 10; t. xx., figs. 1—9.

Four British localities, all of somewhat similar character, have yielded this species. One, a pool above high-water mark, in the Isle of Cumbrae, Frith of Clyde, where it was taken plentifully by the Rev. A. M. Norman; the others, brackish pools in salt marshes at Hylton, about three miles from the mouth of the river Wear, at Burgh Marsh, near Carlisle, and at Hartlepool. In all cases sea water could find access to the pools only at the very highest spring tides.

Ichthyophorba denticornis, Claus. Claus, *Copepoden*, p. 199, t. xxxv., figs. 1, 3—9.

Ichthyophorba hamata, Liljeborg. Claus, *Copepoden*, p. 199, t. xxxv., figs. 2, 10—12.

In this case, as in that of *Cetochilus septentrionalis*, Dr. Claus has divided a previously established species, discarding, at the same time, the original name. It is difficult to decide to which of Claus's species Liljeborg's descriptions and figures (*I. hamata*) are meant to apply; it is, indeed, possible that both species have "sat" for the one portrait, but as, in most respects, the original figures of *I. hamata* agree with the new *angustata*, I have, on principle, retained the prior name. The peculiar fifth foot of the male (Fig. 4) separates the genus from every other, and the two species (besides minor differences) may be distinguished by the presence or absence, on the outer edge of the basal half of the superior antenna, of several strong toothed processes, these being present in *I. denticornis* and wanting in *I. hamata*. The two forms occur mostly intermixed, and I have them from Shetland, the Channel Islands, and the Durham coast. The genus is mostly pelagic.

Anomalocera Patersonii, Templeton. Baird, *Brit. Entom.*, p. 229, t. xxvii., figs. 1, *a*—*i*; 2, *a*—*c*.

A species first described by Mr. Templeton in the *Transactions of the Entomological Society*, vol. ii. (1837), and

afterwards, under the name of *Irenæus splendidus*, by Goodsir, in the *Edinburgh New Philosophical Journal* for 1843. Dr. Claus, in his recent monograph of the Copepoda, has adopted Goodsir's generic name, on the ground that *Anomalocera*,* which evidently has precedence, is inapposite, as all the family to which this species belongs have the males with dissimilar antennæ. But if we admit the right of authors to ignore prior names, merely on account of a fancied impropriety, which gives rise to no manner of inconvenience, we shall speedily have our nomenclature in a state of inextricable confusion. We therefore adhere to the original generic name of *Anomalocera*.

A. Patersonii is the finest of all the British Copepoda, both as to size and colouring. When alive it glows with a splendid iridescent lustre, the prevailing colours being blue, red, and green. The antennæ and caudal segments are mostly a brilliant blue, while the body is mottled with varying shades of red and green. The specimens from which our coloured plate was drawn were taken by the Rev. A. M. Norman, on the east coast of Scotland, in the summer of 1863, and having been mounted while alive in a gelatine medium, still preserve their colouring in its original brilliancy. The species seems to be distributed generally throughout the British seas.

Pontella Wollastoni, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

Of this species I know nothing. It is, however, in all probability, identical with *P. Helgolandica*, Claus.

Pontella brevicornis, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

A fine species taken by Mr. Lubbock at Weymouth, and by the present writer in the Channel Islands.

REFERENCE TO PLATE.

Fig. 1. Upper antenna of male *Tachidius brevicornis*, magnified 200 diameters.

Fig. 2. Lower foot-jaw of *Thalestris longimana* (copied from Claus).

Fig. 3. Upper antenna of *Dias longiremis*, magnified 60 diameters.

Fig. 4. Fifth foot (right) of male *Ichthyophorba denticornis*, magnified 50 diameters.

Fig. 5. Abdomen of female *Temora velox*, with spermatophores attached, magnified 40 diameters.

Fig. 6. Male *Anomalocera Patersonii*, magnified 30 diameters: *a*, rostrum, or beak; *b*, upper antenna (right); *c*, upper antenna (left); *d*, lower antenna; *e*, foot-jaws; *f f f*, swimming feet; *g*, fifth foot (right); *h*, fifth foot (left); *i*, abdomen; *k*, eye.

* From ανωμαλος, dissimilar; and κερας, a horn.

RETARDED EBULLITION—BOILER EXPLOSIONS.

Professor Dufour, of Lausanne, has a long and interesting paper on the "Retardation of the Ebullition of Water, and on a Probable Cause of Explosion in Steam-Boilers," in the *Archives des Sciences*, No. 83. We shall select the prominent passages, which will show the character of the facts which recent researches have made known in reference to these questions.

M. Dufour commences by observing that the law usually admitted as defining the relation between the boiling point of any liquid, and the pressure upon it, is subject to numerous exceptions. Gay-Lussac observed that the boiling point of water and other liquids was retarded by glass vessels. More recently MM. Marcet, Donny, Magnus, and others, have written on the subject, and Mr. Grove has described experiments in boiling water more or less deprived of air, and he has remarked that no one has yet seen the ebullition of perfectly pure water. Three years ago M. Dufour published an account of observations on water and other liquids heated in the midst of a fluid of the same density, and consequently withdrawn from contact with the solid walls of the containing vessels. Under such conditions water could be heated to 170° C., chloroform to 100°, etc. From such facts it appears that a temperature which gives to the vapour of any liquid a tension equal to the external pressure, is the minimum temperature at which it *can* boil; but the temperature at which it *does* boil will depend upon the conditions to which it is exposed, and especially those of contact with solids or gases.

After describing the apparatus which he employed, M. Dufour gives the following results:—"When after a first heating, not carried to the boiling point, the water is allowed to cool and arrive at a given temperature (t): if the pressure is diminished until it becomes equal to the elastic force of vapour at that temperature, boiling occurs exactly at the point required by Dalton's law, or a few tenths of a degree below it."

"When the liquid has boiled for some minutes before being allowed to cool, and suffer the diminished pressure, sometimes it will commence ebullition the moment the elastic force of its vapour equals the pressure, while at other times ebullition will be retarded more or less considerably."

"When the liquid has been boiled three, four, five, or more times before being allowed to cool, and suffer diminished pressure, the retardations of boiling become much more frequent and form the rule not the exception, . . . some-

times exceeding 20° and even 30° C. After a third re-heating it is seldom that boiling occurs at the normal point."

Professor Dufour then tabulates his experiments, showing, according to the circumstances just explained, retardation of the boiling point ranging from 1°·7 C. to 23°·2 C. He then adverts to the well-known fact that the presence of platina wire assists ebullition; but he tells us that, "while it is rare, after a first or even a second heating, that water containing platina remains calm and liquid, when a diminution of pressure affords conditions under which it might boil; if it is exposed to prolonged and successive re-heating, retardations at last appear as in the preceding cases. The platina ceases to excite a change of condition, and behaves at the bottom of the water just like the walls of a glass vessel. We thus see what chemists have often noticed, that platina, having served for some time as a preventive against concussions, at last becomes inactive and the pieces of wire have to be renewed."

In former experiments Professor Dufour showed that globules of water heated beyond 100° C. when surrounded by other fluids of the same density, boiled furiously if touched with pieces of wood, paper, cotton, etc., and he now finds that, like platina, these various substances lose their power by frequent or continuous use. Partial renewals of the water occasioned diminution in the retardation of ebullition.

Professor Dufour remarks that, according to experiments hitherto made on the retardation of the boiling point of water, it has been supposed that this effect is only witnessed in vessels of glass or porcelain. He adds in a note, that M. Magnus records an instance of retardation in a vessel of platina, and goes on to say that when ebullition is excited by diminishing pressure, water in contact with divers metals retards its boiling point, and thus the mere contact of a metallic surface is not sufficient to counteract its tendency to maintain the liquid state.

"When water is in a state of retarded ebullition it presents, in appearance at least, no special activity, although a very abundant and exceptional surface evaporation is really going on. It looks motionless and calm; no bubbles of gas or vapour disengage themselves from the mass or from the walls of the vessel. This liquid condition is analogous to an instable equilibrium, and ebullition may supervene all at once. The sudden transformation of a portion of the liquid into vapour sometimes occurs without any appreciable external cause; but we are nearly sure of provoking it, by giving a shock to the vessel, and sometimes we can do so by admitting a small quantity of air. It is not rare to see ebullitions follow a tolerably loud noise, such as a blow struck in an adjacent

room, or the shaking occasioned by walking over the floor." Professor Dufour compares this action to the effect of agitation in exciting crystallization in super saturated solutions of sulphate of soda.

After reference to experiments of M. Marcet and others, the Professor observes that if the presence of a layer of gaseous matter on the surface of a liquid excites its ebullition, it must be interesting to know what effect would follow from keeping a gaseous layer constantly renewed on the surface of a body plunged into water. To ascertain this he immersed two platina wires in water, and rendered them inactive by repeatedly boiling the liquid. It was then possible to obtain retardation of the boiling point to the extent of 10° or 15° C. A galvanic current was then transmitted through the wires, and gases were continually evolved from their surfaces, and it became impossible to obtain the least retardation of the boiling point. The currents of oxygen and hydrogen starting from the two electrodes, acted as provocatives to ebullition, the moment the change of pressure rendered that phenomenon possible." When ebullition had been retarded to the extent of 15° or 20°, and was suddenly excited by the electric production of these gaseous currents, an instantaneous commotion occurred as if gunpowder had been ignited.

It might be thought the electric current and not the evolution of the gases occasioned these effects; but Professor Dufour thinks the following experiments show that the gas is the effective agent in the case. "When a certain quantity of water covered with oil is heated, by means of a bath, in a vessel of porcelain which has for some time previous held sulphuric acid, it is easy to obtain under a normal pressure a retardation of 6° or 7° C. If thin platina wires, that have been rendered inactive by prolonged contact, are introduced, the facts just cited may be observed, namely, retardation of ebullition so long as the current does not pass, and its excitation as soon as the current does pass. The ebullition thus produced commences immediately round the platina wires only, and not in the space between them that forms part of the circuit. If the platina wires are replaced by copper wires, also made inactive, ebullition commences about the negative pole only, where hydrogen is evolved; the positive pole where the oxygen unites itself to the copper, and where, consequently, no gas escapes, remains perfectly quiet, and is not the seat of any ebullition."

"When the electrolysis is continued for a few minutes, and the surface of the platina wires become covered with adhering globules of gas, which remain even after the interruption of the current, these globules gradually detach them-

selves, taking more or less time about it. Now, if it is only the contact with the gaseous globules that excites ebullition, this phenomenon ought to be seen even after the current ceases, and the wires ought not to become inactive till the current has ceased for some time. Experiments made in various ways show that this is the case."

When solids promote ebullition, Professor Dufour now considers it may be owing to the gaseous matter that adheres to them, and he thinks the power charcoal possesses of condensing gases on its surface, is the cause of its efficiency in avoiding commotions during the ebullition of many liquids.

"The phenomenon of ebullition," he states, "includes two actions: a disengagement of vapour throughout the mass of a liquid, which becomes passible as soon as the elastic force of its vapour is equal to the incumbent pressure; and the molecular action, obscure in its intimate character, by which the liquid is changed for the gaseous form." Contact with certain foreign bodies, and especially with gases, appears to give rise to this molecular action, and consequently to determine ebullition as soon as the state of pressure renders it possible."

Professor Dufour considers that this molecular action is distinct from cohesion, a force which opposes the division of a liquid mass into smaller masses of the same kind. Steam is not, he says, an *aqueous dust*, and in order to produce it something more than simple molecular separation is required.

Passing more immediately to boiler explosions, Professor Dufour observes that in a great many cases they occur when an engine is at rest, and when the boiler has experienced a certain amount of cooling. When this cooling occurs, it takes place most rapidly above the surface of the water, and has the effect of lessening the pressure of vapour that fills the upper part of the boiler, and then, although perhaps seldom, the ebullition of the water may be retarded as already explained, and be made to begin suddenly by any concussion.

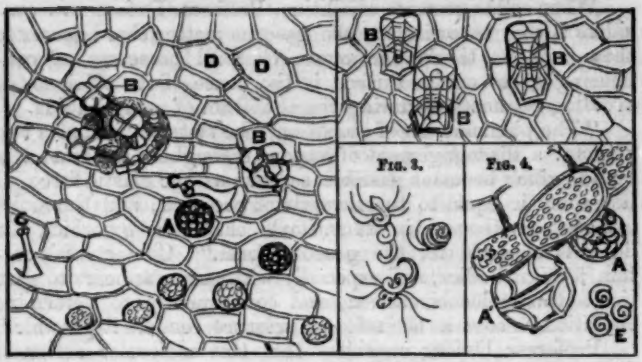
Small quantities of sulphuric acid materially help the retardation of the boiling point, and two explosions at Aberdare seem traceable to the employment of slightly acidulated water.

Professor Dufour considers that an apparatus to produce an evolution of gas by electrolysis, or an arrangement for the agitation of the water in boilers, might assist in preventing their explosion.

THE GERMINATION OF FERN SPORES.

BY THE REV. F. HOWLETT, M.A., F.R.A.S.

Fig. 1. 200 Diam. Fig. 2. 200 Diam.



400 Diam. 400 Diam.

Fig. 1. Portion of prothallium of *Filix-mas*. A, Antheridial cells; B, Archegonia; C, Sort of paraphysical filament; D, Ordinary cellular tissue, but granules of chlorophyll are omitted.

Fig. 2. Portion of prothallium of *Lastrea recurva*, with group of hexagonal lantern-like archegonia.

Fig. 3. Antherozoids of *Filix-mas* in various positions whilst swimming.

Fig. 4. Portion of margin of prothallium of *Osmunda regalis*. A, Immature antheridial cell with imperfect antherozoids; A'. A full-grown but empty cell; showing the way in which the antherozoids (E) lie spirally curled up in the water, upon first emerging from it.

To any one possessing a fairly good microscope, and who is desirous of witnessing some of the most curious and beautiful phenomena that are to be found, perhaps, within the whole range of natural history, a method shall be described in this paper whereby a rich fund of interesting botanical research may be provided for the ensuing spring and summer, within wonderfully limited territories, and at a very trifling expense.

It is true, a little trouble and care are requisite in the investigation, but, to an intelligent lover of nature's microscopic wonders, the results will be well worth the pains bestowed upon it.

Our subject is the germination and development of the spores (or seeds, as they are sometimes though not quite correctly termed) of different species of those elegant cryptogams, the Ferns. A paper on the same subject appeared in the

29th number of the INTELLECTUAL OBSERVER (for June, 1864), from the pen of Mr. R. Dawson, M.B., wherein, amongst a good deal that was interesting and instructive, certain statements were put forth by that writer which certainly demand a few words by way of reply.

But, first, as to the method of observing the phenomena in question.

Having provided oneself with one or more of the round shallow glass troughs, with bell-glasses to match, such as are manufactured at a very reasonable cost by Messrs. Claudet and Houghton, of 89, High Holborn (and called by them propagating glasses), let the troughs be filled about an inch or so deep with clean river-sand. If sea-sand be employed it must be scrupulously cleansed by repeated washings in spring water, to get rid of the salt. Next, having prepared as many small lumps of porous sandstone, each about 1¼ inches square, as you wish to have species of ferns, and having conspicuously scratched a number on each (Roman numerals are perhaps most convenient) for the purpose of identifying your future plants, dip them in clean spring water, and place them on a table which is not exposed to a draught. Then sprinkle separately a *very* small quantity of fern spores on each of your pieces of sandstone—having, of course, previously collected the spores by placing a portion of the mature fronds, whilst in fructification, between separate sheets of note-paper, and preserving the spore dust which will be discharged from them.

Great care is requisite in order to prevent the mingling of the extremely light and almost invisible spores; and it is expedient to open only one packet at a time, dipping a *separate* small feather, or morsel of paper, into one packet after another, and gently rubbing therewith the upper surface of your pieces of sandstone; and, as another precautionary step, it is moreover rather desirable that the stones should be freshly fractured, or at least the surfaces rubbed to a new face, as sporules of various kinds of mosses, *Marchantiæ*, etc., are very apt to establish themselves upon fragments of stone picked up at hap-hazard by the wayside.

Then saturate the river-sand in your troughs with spring water, till it is of about the humidity of mortar, arrange your pieces of stone thereupon, so as you can most conveniently see the numbers, a list of which, specifying the different kinds of ferns, date of sowing, etc., may be advantageously pasted outside your bell-glass for reference.

Place the glasses in a tolerably warm room or greenhouse, but where they will not be exposed at any time to the direct rays of the sun, and after a few days or weeks (according

as the temperature or season of the year may vary) each piece of stone will be seen to be covered with a delicate green efflorescence, like the fine pile of a velvet, or plush. These are the germinating spores—called in this stage, and for some months afterwards, prothallia, or first-leaves; though, indeed, the stones should occasionally be submitted for a brief while (so as not to suffer them to get too dry) to the microscope before any such green efflorescence becomes visible to the unaided sight, inasmuch as the very first stage of growth (which it is of importance to note, it being a moot point as to whether germination takes place indifferently, or not, from *any* point on the surface of the spores) is quite imperceptible without the microscope.

Instead of, however, taking the pieces of stone from off their moist bed of sand, it is a better plan to scrape off a few of the spores from time to time with the point of a scalpel, and submit them to a moderate microscopic power, say $\frac{1}{4}$th object-glass, to see how they are getting on. It may be observed, in passing, that the spores would germinate readily if the stones were simply placed in a trough of water —but then the slightest disturbance of the vessel containing the miniature plantation would infallibly cause the spores to be washed about, and to be commingled; unless, indeed, the stones were of a cumbrously large size.

But, supposing the spores to have duly germinated, now comes the wonderful part of the story—so wonderful, indeed, that it is not surprising that it has been doubted by Mr. Dawson, and perhaps others, who have not been fortunate enough to witness it; though the writer of this paper, during the six years that have elapsed since he first turned his attention practically to the subject, has verified the phenomena scores and scores of times, and has had the pleasure of showing them to numerous friends, amongst whom he has the honour of including one of the profoundest philosophers of our or, indeed, any other time, the gifted Sir J. W. Herschel, and who expressed himself as much struck with what he had witnessed.

When the prothallia are sufficiently advanced in their growth, and which circumstance will vary, as we have said before, according to the different amount of temperature they may have enjoyed, and to the different periods of the year (the phenomena about to be described being rarely or never seen, so far as the writer has observed, between October and March), small circular vesicles, each about the size of the whole original spore, will be seen to stud either the edge or the under surface of the little prothallia; which last will be observed to assume very different forms, being regulated in this

matter partly by their species, and partly by the density or sparsity of their growth. Very frequently, and especially amongst others, in the cases of the golden fern (*Gymnogramma aurata*), of *Strathopea germanica*, and the noble British fern, *Osmunda regalis*, these vesicles will be found to be most conveniently and conspicuously placed upon the very *edge* of the prothallia, and consequently in the best possible situation for microscopic examination. These are the "antherozoidal cells," and being as transparent nearly as glass, their contents are perfectly revealed under a good microscope. Before they are quite mature they will be seen to be filled with crowded semi-transparent greenish granules, which become more and more pellucid as they approach maturity, until at length they are each seen to assume a distinct form, something like a minute transparent spiral shell, and to each occupy a separate cell within the common enclosing vesicle.

If now, when thus mature—and the *successive* arrivals of the prothallia to this stage extend over months, from one single sowing, and from off the same piece of sandstone, so that sooner or later they cannot fail to be in the right condition; if, when thus mature, two or three of the prothallia are carefully picked off the damp sandstone by means of a needle, and immersed in a drop of *water* between two pieces of glass, the little spiral shell-like bodies will in a very few minutes be seen to start out, somewhat suddenly, from the extremity of their enveloping antherozoidal vesicle; and after lying quietly in the water for one or two minutes will then unfold themselves, and assuming a corkscrew sort of form will launch away into the circumambient fluid, and wheel and sport about as merrily as a swarm of gnats on a summer evening! Anything more like voluntary and vital action (animal vitality) it is impossible to conceive; and the analogy indeed which they bear, there can be little doubt, to certain phenomena in the animal economy, will strike every microscopic anatomist, and may well excite our admiration of that harmony of design, and unity of purpose, manifested throughout nature by the great Author of all things. For other marvels yet remain to be told respecting these antherozoids. Some one or other of these erratic atoms meet with another cellular organ, called the archegonium, either on their own or some neighbouring prothallium; and, according to the testimony of Sumniski and Mercklin, as quoted by Mr. Dawson, and of Hofmeister, as quoted by Dr. Carpenter (see *The Microscope and its Revelations*, page 404, ed. 1856), they have been seen to descend down a narrow orifice in the same, until reaching what is believed to be the germinal-cell at the bottom of the archegonial shaft, they fertilize the cell; in like manner as the pollen from the anther of a flower

fertilizes the germ-seeds through the channel and instrumentality of the stigma and pistil.

The author of this paper has never yet actually witnessed the descent of the antherozoids into the archegonia; though the latter organs, along also with the antherozoidal vesicles, and the antherozoids themselves, are all distinctly visible in certain specimens of the prothallia of *Filix mas* immersed in a solution of acetate of alumina and distilled water, and mounted permanently for the microscope; and which have now maintained themselves in a state of perfect preservation for about four years. See Fig. 1.

That the archegonia are truly thus fertilized, seems to be shown from the fact that the true rhizome and fronds of the young fern are always seen to spring, eventually, from a point immediately in contact with one of the archegonia, situated near the upper part commonly of the prothallium, and (as in the case of *Filix mas* and others) on what would be its central line, did any such line exist, but which does not.

The antherozoids, when set free, may be seen as spiral, club-headed organisms, furnished near the thickest part with six cilia, with which they vigorously propel themselves with a peculiar wriggling, jerking motion, through the water. But both these undoubted facts, as well as the fertilization of the archegonia by their instrumentality, are considered as too romantic by Mr. Dawson. "The compromise," he says (see INTELLECTUAL OBSERVER for June, 1864, p. 337), "between animal and vegetable impregnation is too obvious to be real; besides, what are the cilia and curved tail for? impediments rather than aids to going down a straight tube; and cilia are for swimming, but where has the Leander to swim to his Hero?"

To this, the author of this paper replies—"Because it is *requisite* that the antherozoidal bodies *should* swim, therefore we see that they *are* furnished with cilia! I have witnessed all these facts repeatedly, with one of Messrs. Smith, Beck, and Beck's magnificent first-class microscopes, now in my possession, with even as low a power as 60 diameters. And as to the question, 'Where has the Leander to swim to his Hero?'—if by this is meant, where is his Hellespont? I would answer thus—paraphrasing the well-known beautiful, but rather boisterous glee—

> "Of water alone he wants no more
> Than the prothallium supplies,
> When a dew-drop lies
> On its leaf, on a summer morning!"

And again, writes Mr. Dawson, "I have carefully observed these bodies" (the antheridia, he means, and archegonia),

"which are clearly to a demonstration nothing but roots and stomata in all stages of development; * * * but that they" (*i.e.* the antherozoids)" have tails and whiskers is pure imagination." If Mr. Dawson, nevertheless, or any other gentleman will spend an hour or two with the author of this article, next spring (if spared to see the "green leaves come again"), he will go away without any shadow of doubt about the stirring fact of those masculine appendages to the antherozoidal bodies!

But one word more, as a critic, and that with respect to the doubt expressed by Mr. Dawson, as to whether it be true, as stated by Balfour, Moore, Carpenter, Lindley, and Hofmeister, that germination takes place indifferently from any point of the surface of the spore, and not from fixed points. The writer must confess, and that with great diffidence, in the face (if it be really so) of such high names, that he does somewhat participate in Mr. Dawson's doubts; though he may, very possibly, soon have to retract even this modicum of dissentient opinion. And now his attention is called to the point, he will find, probably, but little difficulty (owing to the abundant means for investigation at his command) in satisfying both himself and friends on this question; his only reason for at all demurring to the opinion of the eminent writers above mentioned, arising from the peculiar forms and ornamentation of certain fern spores, which would seem to bespeak a special relationship and subservancy of parts one to the other, and not an indefinite one as regards germination.

It may be observed, lastly, that whatever ferns may do when left to natural circumstances in their native haunts, they only attain their growth very slowly when propagated on sandstone under bell-glasses. At least, spores of *Filix mas* and *Pteris tremula*, for instance, which were sown in the early spring of 1859, and potted in 1862, only began to exhibit fructification on their fronds in July 1864. On the other hand, whilst probably not one fern-spore in a million (if that proportion, even) germinates when left to nature, nearly every one of them will grow when under the artificial treatment described in the preceding pages. It is, not, however, to be concluded that the countless millions of spores which fail to germinate do not fulfil some more or less important part in the hidden economy of Nature.

A BRIEF HISTORY OF A RIVER TANK.

BY SHIRLEY HIBBERD.

An object with which most of my friends are familiar is a plain rectangular tank, containing rockwork, water, and gold fishes, and which occupies a conspicuous place in the entrance-hall of my residence at Stoke Newington. It is such a very unpretending affair that I dare say many of my friends will at this stage of my "brief history" think that I have made a mistake in selecting such a subject for a paper in the Intellectual Observer, but if they will just read on, I have no doubt I shall be able to satisfy them that my tank is an object of some interest, not only to myself personally, but to the cultivators of aquaria everywhere. In the *Book of the Aquarium* I have endeavoured to expound the "natural system" of tank management, which, as its name implies, is the only system by which satisfactory results of a permanent nature are to be obtained. The history of aquaria in the most extensive sense, is simply a history of the rival pretensions and diverse results of the artificial and natural systems of management. The artificial system is, perhaps, no system at all, because the practitioner seeks merely to gratify his fancy in forming an assemblage of aquatic plants and animals; the tanks are elaborately decorated with fountains, grottoes, and banners of vegetation, and stocked with crowds of fish.

Under some circumstances the artificial system answers admirably; in others it is a failure from the first, and every repetition of the experiment ends in the same disappointment. For all show purposes the artificial system is invaluable. It has often been my lot to exhibit tanks at soirées, conversaziones, etc., and they have always been greatly admired; but so thoroughly artificial have been the arrangements that I have sometimes taken up from the garden tufts of *Holcus saccharatus*, *Arundo donax*, and other large plants of graceful habit, and, having washed the earth from their roots, have planted (*i.e.* fixed) them in good positions, *pro tem.*, for crowds of gold fishes, minnows, bleak, etc., to gambol amongst. I remember some years ago, when visiting Leeds to deliver some lectures on aquaria, I had the privilege of inspecting the tanks of Dr. Hobson, which were the most satisfactory exemplifications of artificial management I had then or have since seen. A very elegant room was appropriated to a series of vessels, in which was kept up a constant and copious run of water, the stream passing from tank to tank, the tanks being in a succession of levels, so that from one end of the room

all were visible in an ascending series, which produced an agreeable *tout ensemble*, and at the same time made one source of water supply sufficient for the whole. This was a strictly artificial arrangement, but it was perfectly successful. The tanks were all well stocked with fishes, reptiles, insects, etc., classified according to their habits and proclivities, and so grouped that when viewed collectively, the scene was beautiful in the extreme. One more instance of artificial management for show purposes will, perhaps, suffice. When lecturing at the Reading Institution some years ago, I had an accident, and spoiled nearly all the sea-water that had been secured for the display. But I was not to be beaten by trifles. I had enough sea-water left to fill a few large shallow glass pans; into these pans I transferred the anemones, star-fishes, etc., and gave them just enough water to cover them, and in the show tanks I grouped the large handsome specimens of algæ that had been collected for the purpose, so as, with serpulæ shells, rocks, etc., etc., to make handsome groups, and filled those tanks with water drawn from the Institutional water-butt, and kept the secret to myself from that day to this. That was a perfectly successful undertaking; the tanks looked beautiful by gaslight, with their grand groups of algæ, and as for the animals, the thin film of water over them, and their recent travel and subsequent transference from their places in the tanks, caused just enough of that peculiar irritation which seems to be needful to cause a full display of the beauties of certain of the Radiates, and the audience had the advantage of beholding star-fishes, plumose anemones, and other marine subjects, in the attitudes they habitually assume when safely anchored fathom deep in ocean brine.

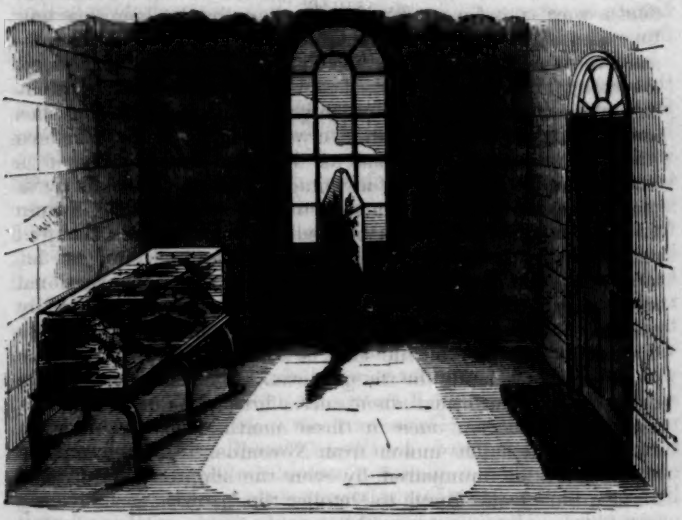
The natural system is an imitation of nature, not in outward appearances merely, but in *conditions*. Tanks managed on the natural system may be made to have a most beautiful appearance, and I flatter myself that the example I am now to bring before you could not be easily surpassed for beauty, considering it simply as an appropriate item in a "home of taste." But it is impossible to use such vessels for show purposes; any disturbance of the furniture would be a violation of the most essential conditions, and mere decorations are not to be tolerated; they are, in fact, forbidden by the laws on which the system is based. How do we proceed to carry out the natural system? We form within a vessel or vessels a group or groups of objects in imitation of rock-pools, running streams, lakes, ponds, and so forth. If it is intended to keep in any of the vessels creatures that habitually dwell in mud, there must be a bottom of mud for them. If retiring places and dark recesses are needed, they must be built; whatever is to be the

purpose of any particular vessel, it must be prepared in the first instance so as to contain within itself all the conditions essential to success, and when it is completely stocked it must be left to take care of itself; and if it becomes unsightly, or the animals become diseased and perish, then in that particular instance the natural system has failed through some error or oversight of the practitioner. Of course in all this there is much that is artificial; for instance, it is artificial to put fishes into glass vessels of any kind, and very artificial to build miniature caves and grottoes of coke or broken bricks; but the term natural system is nevertheless quite legitimate, because the endeavour at every step is to illustrate the operation of natural laws; whereas on the other system the endeavour may be simply to carry out a fanciful device, or a scheme which in its first elements sets the laws of nature at defiance.

The tank I have to describe was fitted and furnished more than seven years since. It is a simple rectangular vessel, in form nearly a double cube, and its position is in the entrance-hall adjoining the rear wall, where it is sufficiently illuminated to render every part of its contents agreeably visible to the eye, yet it receives scarcely any direct light whatever. It is impossible there should be anything more simple than the furnishing of this vessel, yet it does not lack certain features that render it attractive to unscientific eyes. I fitted it myself, and proceeded as follows:—I procured from the cellar a number of large pieces of coke, some of which were broken, to afford ample choice of blocks of various forms and sizes. Those were preferred which had a somewhat rugged face, but which nevertheless were large and flat, giving plenty of linear surface, so as to be best adapted for building a wall of very moderate thickness. These were two or three times dipped into a thick batter of Portland cement, and were finally cemented together in blocks of suitable width for convenient lifting, with one or two empty flower pots at the base and within every block. The flower pots were used to create a flat basis, so that each block would rest on the bottom of the tank securely, and for the additional reason of the increased lightness of the blocks so constructed, the fronts being made solid and massive, yet hollow within, and the pots not at all or only slightly covered with rock on the sides intended to form the backs of the blocks. Thus a rugged wall of rock was formed in a series of detached pieces, massive in appearance, yet of no greater weight than admitted of convenient lifting. Such a wall made of mica schist—which is the best of rocks for aquaria where its weight is of no consequence—would soon have ruined the tank, and perhaps have brought down tank and stand within a few hours of the first fitting. With coke and flower-

pots you may build another Tower of Babel, and its weight would scarcely make an indentation on a newly-ploughed field.

The rocks were, as soon as tolerably hard, placed in a large vessel of water. A tank in the garden used for ordinary garden purposes, answered admirably for the soaking process that all newly-cemented work must undergo before it should be used in an aquarium. The only preparation the tank itself underwent was to colour the back, so that glimpses of the wall should not be seen through any possible interstices of the rockwork. I took some sheets of green tissue paper, smeared the back plate of the glass all over with copal varnish,



pressed the paper smooth on it, and by that experiment determined that if it ever becomes needful to colour one side of a tank, the paper and varnish is the most effectual and cleanly that can be adopted. In due time—a fortnight perhaps, not less—the blocks were taken from the bath and placed in position. A bottom of clean well-washed pebbles was laid down, the tank was then filled with water, and the gold fishes and minnows were introduced.

That is nearly all that has been done to the tank from that day to this. Yet a few things remain to be said. In the first place, it has been a complete success, and the nature of that

success may, perhaps, surprise some of our non-successful aquarians. For instance, the water has never once, during a period of over seven years, been pea-soupy, or even cloudy, or otherwise than as brilliant as all that we have in our mind's eye when talking of the "crystal spring" and the beverage of Castally. There have been deaths in it—deaths by compulsion, the result solely of experiments made with a view to test the extreme capabilities of the system; but there are in the tank at this time gold fishes that I have had in my keeping, and that have never been otherwise than healthy and happy, during a period of *more than nine years*. If any of our readers have kept gold fishes in glass vessels as long or longer than I have, I should much like to hear of it, and with the fact a word as to the conditions. Furthermore, to keep this tank in order is a matter of such small trouble that it may be literally said to take care of itself. Ordinary dusting and occasional cleansing of the exterior are, of course, necessary, and for the interior there are two operations only that are needful. The fishes are fed with rice boiled in water, or with bread crumbs. I believe that bread is as good a food as they can have, and as it is always handy, it is a great advantage to be able thus simply to perform a duty which is generally too much neglected, for there are still to be found some benighted people who think that gold fishes can live on the invisible tenants of the tank, and get fat, as it were, upon nothing. The other operation is the occasional cleansing of the front plate inside. This is accomplished by means of a piece of sponge, attached, by means of twine, to the end of a stick, and the stick is thrust behind the tank, so as to be always handy for the purpose. This cleansing of the front plate is performed about once a fortnight during summer, and not more than once in three months during winter; in fact, it might be left undone from November to March, and the view would be unimpaired by even the slightest film of confervæ; but from March to October the growth is sufficiently rapid to produce a perceptible green tinge on the glass in eight or ten days, and this is easily removed by the sponge. In cases of long neglect I find the most effectual mode of cleansing to be with a cloth on which a little silver sand is sprinkled; this, drawn over the glass with the sand, brings away the crust at once, and if carefully done, appears not to cause any serious scratching of the glass, though if the glass were of poor quality, perhaps it might.

The reader has of course taken note of the omission from this history of all mention of the introduction of plants to the tank. I have never introduced a plant of any kind, yet the rocky wall is richly coloured with microscopic forms of vegetation in beautiful green, bronze, and russet patches, and if the

glass ends are left untouched, they in time become quite opaque with a dense coating of olive-coloured vegetation. This is one of the grand features of the natural system. I may introduce a thousand plants, Anacharis, Valisneria, Stratiotes, etc., etc., and they may all perish. But those Dame Nature introduces are sure to live. Being developed *in situ* they are of constitutions adapted to the conditions which exist in the tank, and though it requires a long time for a vessel, *situated as this is*, to become richly clothed with suitable oxygen makers, some supply of oxygen is secured from the very first, for I have seen ciliated spores and beginnings of genuine vegetable deposits within a few hours of the first furnishing of a tank. Hence it was that, fortified by previous experiences of the natural system, I did not hesitate to introduce the fishes as soon as the tank was furnished, without waiting for the full development of the microscopic forest, for I knew that before the fishes exhausted the oxygen in the fresh river water, there would be the beginning of a new supply for them, and there was never any distress through that procedure.

I have italicised above the words "situated as this is." The situation of this tank is the secret of its success. Near it on one side is a window facing west. This window lights the hall abundantly, but very few rays of light from it fall directly on the tank. The only direct light which strikes upon the tank comes from the fanlight over the door directly opposite, and that is, of course, but moderate in amount. Now, in the early days, when I wanted a quick growth of Oscillatoria, and other oxygen makers, I had the blind drawn up at the side window, and there was then no fern case there. The abundance of light caused a speedy diffusion and germination of spores, and as soon as I saw that the vegetation was likely to be too plentiful, I had the blind drawn down, and intercepted the light that still came by means of a fern case. Thus by toning down the daylight, and having my tank where an excess of light was impossible, I secured a moderate, yet plentiful growth of plants, and have never had one vegetable filament more than needful, except on the front glass, where of course it intercepts the view of the interior. It must not be supposed, however, that the hall is dark in consequence, it is, in fact, well lighted, and very cheerful.

Now a word for the fishes. I find that for a vessel of this sort, which though to me an experimental and scientific affair, is in all other respects a piece of elegant furniture, there are no fishes that may be kept with such certainty as gold carp. My old friends of nine years' standing (or swimming) have gone through several severe trials and seem none the worse. I cannot say how much they have grown during

this long period; but I think they have grown, though certainly very little. They are tame and lazy, and happy and beautiful, and they have served an important purpose to me besides the adornment of the hall, for, after their seven years' habitation of this tank, having had two years of active experimentalizing previously, they have solved the problem of the cubic space required by a fish for breathing room, and I shall be able to give a safe rule for the guidance of all cultivators of aquaria. I have arrived at the maximum capacity of my tank in various ways. One way was to introduce occasionally a few new fishes. As common carp abound in a pond close by, a good many have had temporary residence in the tank. Minnows have been used in the same way, and I have also added gold carp, and other fishes which are generally tolerably adaptable in constitution. But it always happened that when the fishes exceeded a certain number there were signs of distress. I could not begin changing the water to obviate this, because that would be to annihilate the natural system "at one fell swoop." No, the water has never been changed during the whole seven years, though, of course, it is necessary occasionally to make good the loss by evaporation. But I did try on a few occasions of extreme distress to aërate the water by the use of a garden syringe. Charging this from the tank the water was ejected back with force through some slight atmospheric distance, carrying streams of bubbles to the bottom of the vessel. This would be amusing, because the fishes would rush at the streams of bubbles and absolutely gulp them; but it was fagging work, and, of course, was only performed by impulse and not by system. The end of every one of these experiments was the same. One or two of the newly introduced fishes would, after the lapse of about a fortnight, be found dead and "floating on its watery bier." Next a few more would die, and so on till the whole of the new comers were cleared off, and the old, well-seasoned members of the "happy family" remained unhurt, but breathing more freely for the relief, and no doubt rejoicing to have got rid of the innovators. Suppose now that you have some gold fishes, averaging four to six inches in length, to preserve for any length of time by the natural system, and under circumstances at all resembling the case here described, for half-a-dozen of those fishes you must have a vessel holding at least twenty-four gallons of water. The smallest of your fishes will need three gallons, all larger four or five gallons. Most of the failures in tank management have resulted from over-stocking, but the modification of the light is an equally important matter.

The natural system can be carried out in marine tanks in much the same manner as in river tanks, though, of course,

the cases differ in many respects. In a marine tank which has been in operation four years, and is scarcely ever touched or disturbed in any way, I have some British mollusks that were introduced in the first instance, still in perfect health. During the very hot weather of the past summer I lost two or three periwinkles, but I have still several of the periwinkles living, after four years' residence in the vessel, and during the whole of that time there has been no vegetation except such as is strictly microscopic.

NOTES ON FUNGI.—No. I.

BY THE REV. M. J. BERKELEY, M.A., F.R.S.

A FEW years since there were scarcely half a dozen persons who made Fungi an object of study, or who were at all aware of their importance in the economy of nature. At present, thanks to the popular work of Dr. Badham, and to more scientific helps which were previously unattainable in our own language, there is a growing desire to become more intimately acquainted with them, a desire which is checked only by the extreme difficulty of the study, especially of that more important division Agaricini, which comprises a great part of the species which are used for food, or respecting which a mistake may lead to fatal results.

Every accident, however, which arises from the use of dangerous fungi is not attributable to ignorance. Peculiarity of constitution, or, as it is called in the language which is frequently so annoying to judges in the course of trials where medical evidence is necessary, idiosyncracy, has a great deal to do with it. The incompatibility of every kind of shell-fish with some constitutions is notorious; and I know an instance where the smallest quantity of egg acts as a pernicious ferment, inducing a variety of unhappy consequences. This, however, is not all. The cases of death or illness from fungi mostly arise among the poorer classes; and it is not wonderful if, after a hard day's labour, when a pound or more of coarsely dressed mushrooms is consumed without due mastication, a severe fit of colic or dysentery should take place. Where the esculent Agarics are consumed in moderation and eaten with a proper quantity of bread, I believe that they are perfectly wholesome, as Wildenow found them when living on them for weeks to the exclusion of other food, except the coarse German bread.

The prejudice against anything except the common mushroom, and a particular form only of that, is so strong in this country amongst the poorer classes, that there is little prospect of their availing themselves of the bountiful feast which is prepared for them in the fields—a prejudice so strong, that even amongst educated people I have known instances in which persons had arrived at thirty years and upwards who had never ventured to taste even a mushroom. There are, however, numerous persons who wish from curiosity or from some better motive to become accurately acquainted with these productions; and it is with a view to facilitating their studies that these notes are commenced with the genus Agaricus, to the exclusion at present of the more nearly allied genera.

The genus Agaricus numbers in the *Outlines of British Fungology* above 350 species, and it is probable that when the British isles have been thoroughly investigated, 150 more may be added to the list. The difficulty of ascertaining any particular species amongst so large a number, where the distinctions are often very subtle, can scarcely be exaggerated; and yet a few plain rules will remove a great part of the difficulty.

The division Agaricini is distinguished from others by the fructifying organs being disposed on certain gill-like plaits or veins on the under surface. In a few rare instances this surface, or, as it is called, hymenium, is turned to the light in the course of growth, though originally inferior. Several genera are comprised in the group, distinguished by their corky, leathery, waxy, or extremely deliquescent consistence; by their having a veil attaching the pileus to the stem, appearing to the eye as if composed of threads like those of a spider's web; by the interior substance of the gills, whether abounding with a milky juice or otherwise, consisting of little vesicles instead of threads; by the gills being reduced to veins, or by one or two other distinctions which are of little importance as regards British species. The genus Agaricus, comprising the true mushroom, with a multitude of other wholesome species, remains characterized by membranaceous persistent (not deliquescent) gills, their interior substance filamentous and continuous with that of the pileus and their generally acute edge.

Having then obtained something like a correct notion of what a true Agaric is, and being able at once to distinguish the genera, which might most easily be confounded, as the milk-fungi Lactarii, the rigid brittle-gilled milkless Russulæ, the spiderwebbed Cortinarii, with their spores resembling in colour peroxide of iron; the waxy Hygrophori, which adorn our heaths and open meadows with the most brilliant hues;

the tough Marasmii and Pani, which dry up rather than corrupt in decay; the Paxilli, with their gills separable from the pileus; and, lastly, the inky fungi, which in a few hours pass into a black ink-like fluid, though some of these even are esculent in a young state, the student with a real Agaric in hand has to determine to which of the numerous divisions in the genus his species belong.

Now there is a character which will at once enable him to refer it to one of six great groups into which Agarics have been so cleverly divided by Fries—a character which, though like other characters in natural history, is not absolute, but accords with the real affinities of these plants—I mean the colour of the spores. A very little practice will enable the student at once to say to which great group any particular species belongs; but till this tact is acquired, or where doubtful cases arise in the course of more advanced study, it will be well to collect the spores by simply placing the specimen on a sheet of white or black paper, inclosed in some vessel which excludes the air. In the course of a few hours there will be a thick deposit, unless the specimen is too far advanced, or has become dry from exposure to the sun. The spores will be found to be either white, or pink, or ferruginous, or brown, or purplish-black, or black, according with the divisions Leucospori, Hyporhodii, Dermini, Phæoti, Pratellini, or Coprinarii. Amongst the Leucospori in a few instances the spores will have a slight tinge of yellow, or possibly of pink, but not of so decided a character as to invalidate the importance of the distinction; in Dermini there will be different ferruginous shades, partaking more in one case of yellow, and in another of a red tint; but there will be no real difficulty, and the peroxide tint of the spores of Cortinarii will be distinctive enough even apart from the spidery veil. The spores themselves will not very frequently present distinctive characters; but two prominent forms will be found in Hyporhodii, distinguished by great neatness of outline and extreme irregularity; while amongst the Dermini cases will be found where they are studded over with granules, presenting an excellent mark of distinction between species which might otherwise be difficult to separate.

The student having thus ascertained to which of the six main divisions his species belongs, will proceed to the characters of the sub-divisions, or sub-genera. It appears greatly preferable to consider them as sub-genera than as genera, as it keeps the whole under one common view, and there is really no less difficulty in the one case than in the other, though something of the kind is often alleged as an excuse for multiplying generic names.

Before, however, he proceeds further it will be well to have

some mode of preserving specimens for comparison. Now it is true that the softer fungi cannot be preserved as satisfactorily as most Phænogams, but with care they will make useful specimens for the herbarium. If gathered in moderately dry weather, and dried like other plants, after a day's exposure to the air, they will often, if the papers are changed frequently, and well dried before each change, make tolerable specimens. Thin sections may be prepared in separate papers, and both together, after being well washed with a solution of corrosive sublimate, when glued on paper, will give all the principal characters, and the point of a lancet will always enable the student to remove spores enough for microscopic observation. The collection will, however, require frequent inspection, especially to guard against the ravages of mites. A dry room is essential; but apart from this, if the drawers are lined with cedar, few insects, if any, will appear, and a free use of pure benzole will soon destroy any that may resist the cedar. Moulds, perhaps, may be more difficult to guard against, but frequent inspection and a dry atmosphere will do much.

As regards the mode of keeping the specimens, far the best way is to have slips of paper which are multiples of some convenient unit, on which the specimens can be glued according to size, and the slips can then be fastened to sheets of the common herbarium dimensions.

In the next set of notes the characters of the different groups of Leucospori will be given, with notices of the most approved and safe esculent species, as also of those which have been clearly ascertained to be poisonous or deleterious.

THE LUNAR ARCTIC REGION: MARE FRIGORIS: MOUNT TAURUS: POSIDONIUS.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

In our previous description of the neighbourhood of the N.W. lunar limb, we broke off without reaching the Pole. We must therefore now turn our steps in that direction. As a necessary consequence of the very slight inclination of the lunar axis, the arctic zone, properly speaking—that is to say, the region around the Pole where the sun never rises in winter and never sets in summer—is of much less extent on the Moon than on the Earth; its radius being only about $1\frac{1}{2}°$, instead of $23\frac{1}{2}°$. But, as Beer and Mädler observe, this would by no means produce a greater equalization of mean temperature than upon the earth. The question, however, of the distribution of lunar climates and their analogy with those of our own globe is a difficult one, being complicated with the absence of any dense atmosphere, which on the earth materially diminishes the force of the oblique solar rays, and, as we have now learned from Mr. Glaisher's balloon ascents, produces meteorological effects not hitherto fully taken into consideration.

As we approach the Pole we find in the Full Moon a multitude of converging luminous streaks, the major part portions of great circles, but some of irregular curvature. Their point of union is the ring-mountain *Anaxagoras* (No. 46, in the next quadrant).* These streaks, as B. and M. observe, pass over every inequality of ground alike, and are not at all elevated above the adjacent soil. This they satisfied themselves of as fully in this district as elsewhere, by watching their aspect on the terminator, where a bank of less than 150 feet high must have come out in its true relief.

Strabo and *Thales*, two craters of moderate size, will be found close to each other; the latter, which is the more easternly, being the more regular, steep, and brilliant of the two. *Strabo* lies about its own breadth distant from *Endymion* towards the Pole. Some short streaks issue from *Thales*, one running eastward having a very defined edge, like the shore of a sea, on its N. side. When a favourable state of libration brings these objects away from the limb, their aspect is a striking one; the effect of local shading causing *Thales* to stand out as a commanding height, in cold and barren insulation.

N.W. of *Thales*, and considerably nearer to the limb, lies a crater undescribed and unnamed by B. and M., and not

* See Index Map of the Moon, vol. v., p. 190.

made sufficiently prominent in their map. Its long-enduring shadow, however, under a favourable libration, proves it to be a very important object, and one of the leading features of the district, and it would be desirable that it should receive a suitable designation in the enlarged nomenclature which Mr. Birt is engaged in carrying out. This portion of the Moon does not bespeak any especial care on the part of B. and M. It should have been noticed in our last paper that, though they have drawn, they have not described two curious streaks S. of *Hercules*, which distinctly converge upon the little bright crater in its interior, though they are lost before they reach the external foot of the great wall. Between *Geminus* also and *Thales* is a curious arrangement of light and shade, neither drawn nor mentioned by them. As to drawing there is little to be said. It was a hopeless undertaking to combine in one representation the local colouring of the lunar noon with the true relief developed by the shades of morning or evening. A separate picture is wanted for the Full Moon, a chart or diagram for the phases. It would, however, have been more satisfactory to have found some account of a fine broad streak, somewhat like the tail of a comet, which I have seen 3d. 15h. after First Quarter, 5d. 22h. after greatest S.W. Libration, passing from the region of *Geminus* just S. of *Struve*, and forming the S. shore of the *Mare Humboldtianum*, of which it seems to flatten the curve. Between this place and *Endymion* it is subdivided into two or three narrow rays, and between *Mercurius* (a considerable crater N. of *Struve*) and the *M. Humboldtianum*, it is crossed by another remarkably thin, straight, and even streak; the intersection of the two forming a patch of light more brilliant than either of them separately. This is a suggestive circumstance and worthy of attention. The last-mentioned streak is of considerable length; its actual bearing upon the Moon is probably S.S.E., and not far from perpendicular to the other, though foreshortened into great obliquity of position: it becomes gradually invisible either way; in one direction between *Struve* and the limb; in the other, beyond *Endymion*, where if it is not lost, it bends more to the S., or perhaps another ray takes up its course and runs into *Thales*. All this, of which no note is to be found in B. and M., is merely a specimen of what is to be met with in many regions in the high illumination of the Moon.

At some distance E. from *Thales* we come upon a district remarkable for a network of intersecting ridges, by which it is mapped out into separate areas, of various, occasionally even rectangular forms. There seems little difference of level or colour: the ring-mountains which occur are flat: craters, some of them of great brilliancy, have broken alike through the ridges and the plains. Still further N., B. and M. have spoken

of the impossibility of identifying the spots called by Schröter *Lexell* and *J. J. Cassini*. This is not very wonderful, as the old Hanoverian has clearly placed them *in the next quadrant*, on the other side of the First Meridian! We shall revert to this matter in its proper place, remarking only at present that the harmonizing and rectification of the existing drawings of the N. circumpolar region would be a task of considerable difficulty.

Very near the Pole lies *Scoresby* (our No. 7), a ring of considerable depth and reflective power, and one of the best guide-points in this ill-marked district. It has in the interior a crater and two hills, which are very difficult to be perceived; its form changes much of course with the libration, varying from 0·36 of the length to 0·09, when its contour as a crater can no longer be recognized.

The North Pole of the Moon lies in a mountainous district, but on a far less magnificent scale than the one diametrically opposite. The difference between the character of the lunar Arctic and Antarctic regions is plainly seen by the shape of the horns before the first or after the last quarter, the N. being far less broken and irregular. There is no indication whatever of snow. A separate map of this vicinity, very beautifully and minutely executed, with a corresponding description, is given in the *Beiträge* * of Beer and Mädler, from observations taken under a conjunction of circumstances so peculiarly favourable as to be worthy of remark, for the encouragement of those who may have been disheartened by frequent disappointments. 1834, Sept. 17, the moon was on the meridian at 12h. 2m., with a S. latitude of 4° 59′, and was full 9m. afterwards. This remarkable coincidence was further favoured by such clearness and stillness of atmosphere as sometimes cannot be met with for a year together in the climate of Europe. An uneclipsed moon of course cannot be "full," in the proper sense of the word; being always deficient on the side nearest the point of opposition to the sun; and consequently, instead of a circular limb, the N. polar region exhibited shadows enough among its ridges and hollows to bring out their true relief, and enable a drawing to be made. The next night, and three nights at the ensuing Full Moon, proved again so favourable that little had to be added on future occasions. They have indicated the exact site of the Pole in a level between two mountainous ridges, and at the foot of a summit of 9400 feet. These heights deprive it for ever of the direct light of day, but must bestow

* The complete title of this valuable though fragmentary contribution to modern astronomy is, *Beiträge zur physischen Kenntniss der himmlischen Körper im Sonnensysteme*. It contains many original observations on the moon and planets. There is a French edition also, entitled *Fragmens sur les Corps Célestes*.

upon it a faint illumination reflected from their own crests, on which the sun never ceases to shine. From this region the centre of the earth is never seen higher than 7°, and the sun rises only to 1¼° above the lunar horizon.

Mare Frigoris (W. half).—This on our map is the portion of the shading lettered B, extending from the first meridian (which of course stretches between the letters N and S) towards the W. as far as Nos. 4 and 5. (It should be observed, by the way, that the shading on the map is not intended to represent the precise form of the plain, which is very indefinitely bounded, but merely to indicate its general position.) It is a grey level of a feeble yellowish or greenish-yellow grey, and looks often exactly like a strip of cloud lying across the moon. It contains nothing very remarkable. The *Lacus Mortis* is a continuation of it between Nos. 5 and 17. This flat incloses towards its middle a tolerably conspicuous and deep crater named *Bürg*, with a central mountain. Its depth as measured is about 6800 feet.

The *Lacus Somniorum* (C in our map) continues this level landscape, but with many irregularities, as far to the S. as the border of the *Mare Serenitatis* (E), from which it differs by being much less flat and even, as is evident when they are both intersected by the terminator at the same time. "If the supposition," say B. and M., "of a watery covering on the moon were admissible, the *Mare Serenitatis* might have been compared to a deep sea, diversified by islands and insular chains; the *Lacus Somniorum*, on the contrary, to a shallow expanse of water, which allows the irregularities of the bottom to appear through it."

Our guides now carry us across to the range of mountains called *Taurus* (the centre of which is marked 8 on our map). This is an extensive region, bounded by the *Mare Serenitatis* on the E., the *Lacus Somniorum* on the N.E., the *Mare Tranquillitatis* (D) and its subdivision the *Palus Somnii* on the S., and on the W. by the range of large craters extending northwards from the *Mare Crisium*. It readily divides into one great mass to the N. and two inferior groups to the S. and S.W.—the first containing the craters *Römer* and *Posidonius* (9, 10); the second a crater called *Vitruvius;* the third, the craters *Macrobius* (11) and *Proclus* (12). The mountains are for the most part arranged in labyrinthine masses, intermingled with plains and valleys.

Römer (9) is a ring-mountain with a very broad and terraced wall. Its depth is computed to be 11,500 feet (Schröter gave 8600), with a breadth of about 25 miles; and its interior contains a mountain (5000 feet high according to Schröter), and a bright crater. To the N. of *Römer*, Lohrmann, upon

whose Section III. we have now entered, represents some elevated masses much more steep and lofty than any which could be identified by B. and M., the landscape appearing to them, though mountainous, yet much more open. On its E. side we meet with a curious bay, named *Le Monnier*, forming one of the darkest portions of the *Mare Serenitatis*, and bounded by a semicircle of steep and lofty cliffs— the half, to all appearance, of a great ring. Of the other half, B. and M. could find no trace; they did not consider an insulated hill, lying out "at sea," though in the right direction, any portion of it, its height (3100 feet) being far inferior to that of the cliffs, which rise in two places to upwards of 8000 feet, and the faintly distinguishable ridges connected with it taking wrong directions. It must be noted, however, that these are otherwise drawn by Lohrmann, and that two of them, according to his figure, very fairly complete the circle. Minutiæ of this kind must be attended to by those who desire to throw light upon the origin of the lunar formations. Although we are unable to detect the existence of any "degrading" influence upon the surface of the Moon, or to comprehend how its masses once erupted—if such were their mode of creation—could, in the absence of air and water, suffer any change excepting what might result from slipping or earthquakes (the reader will pardon the solecism), yet it cannot be denied that in many places there are indications of subsequent alteration which it is more easy to perceive than to explain. Sometimes we might probably incline to the idea that the appearance was deceptive, and must be referred to other causes; but those again are sufficiently obscure. The question is a curious and interesting one, but requires to be approached with much caution; we find from the example of geologists that even a personal examination of the lunar strata might not exempt us from considerable perplexity. We have already met in the *M. Crisium* with instances which would fall within its range (INTELLECTUAL OBSERVER, April, 1864, pp. 204, 205) and shall have to notice many hereafter. *Le Monnier* is easily recognized under all circumstances of illumination, reminding us in this respect, as well as in its general character, of its gigantic counterpart, the *Sinus Iridum* (K in our map) to be described at a future time.

A little N. of *Le Monnier* we come to *Posidonius* (10), a ring-plain of considerable importance, about sixty-two miles in diameter,* remarkable for the defined outline of its wall, which is, however, of no especial height.† A long curved ridge

* Lohrmann gives nearly seventy-four miles: Schröter, about sixty-nine.

† An evident mistake, probably a misprint, in the text of B. and M., prevents their measures from being available. Schröter gives about 3000 feet to three of its peaks on the E. side, above the *M. Serenitatis*.

branches off from the S.W. part of the wall, and runs along the W. side of the interior, leaving a very narrow, but gradually widening trench between itself and the main wall, and vanishing in a most minute point: it is less conspicuous for height, not exceeding 1400 feet, than for sharpness of contour. Schröter has not represented it very well. The interior is but slightly uneven: it contains a small but deep crater, *Posidonius* A, the definition of which, as of most of the objects connected with this great ring, is peculiarly clear. It is more remarkable in another point of view. 1791, November 1, Schröter saw and represented it as a pretty flat depression or ring-plain, its interior being merely grey, without any dark shadow, while seven other small craters in the immediate vicinity had a very obvious black shade within. On referring to a previous drawing, made 1788, August 19, he found that he had then seen it as an ordinary crater, and so it appeared on the following evening (1791, November 2), as a pretty deep hollow with a black shadow like its neighbours, although of course under a considerably greater angle of illumination than twenty-four hours before. Hence he concluded that on November 1, the shadow, which must have not merely existed but been more extensive, had been concealed by the intervention of something giving the crater a grey aspect; and this again would infer the presence of a lunar atmosphere, however subtle and limited in depth. The valley of Lilienthal in which he lived would present, he thought, a similar aspect, if similarly viewed, when during the month of June the moors were set on fire for agricultural purposes. As an analogous indication he remarks that the careful observer will often perceive, in localities in the Moon where mountains have never been noticed, something like very flat hillocks that seem to come into existence under the eye, and again disappear: and if they should be caught up on future occasions, are always found in some altered form. Some such minute variations he noted in the interior level of *Posidonius*, and thought it possible that they might be connected with the assembled habitations of intelligent beings, "who there, as well as we here, praise the goodness and wisdom of their Maker: at least this hypothetical supposition is not unworthy of the greatness of the Creator of the universe; and appearances which vary in such manifold ways admit of being very well reconciled with it."* Such changes, however, he admits, might be equally referred to clouds, or rather their analogues. And if so,

* It is worthy of note that Herschel I. in his early days, when alone he seems to have paid attention to the moon, expressed his conviction as to "the great probability, not to say almost absolute certainty, of her being inhabited." This impression appears, however, to have been merely the result of her general aspect.

Gruithuisen would fully confirm the idea from his own observations, in which they held a prominent place. But whatever may be our opinion as to these points, which, if demonstrable at all, certainly require more rigorous demonstration, there can be no question that the phenomenon described by Schröter was deserving of attention. It was quite safe from neglect in his hands; he measured the depth of the little crater on two occasions, and made it 3774 and 3504 feet, the correspondence showing clearly that there could be no very material error, with a height of 2070 feet for the ring above the external level; a relative amount agreeing well with the usual proportion on the moon, and showing that there is no improbability in the supposition that the rings are the result of actual eruption. He found also on another occasion (1791, Dec. 30) the interior shadow much too trifling in proportion to its distance from the terminator, so as to give the appearance of great shallowness; but in no subsequent observation with any of his telescopes was the greyness which at first struck him to be found again. Lohrmann takes no notice of Schröter's statement, which is given in great detail: B. and M., as an exceptional case, have cited some part of it, and are disposed to admit its correctness; but they have added so much in the way of disparaging remark that it is obvious what was their real estimate of their predecessor's labours. It must be admitted that to a certain extent they were right, and that many of Schröter's supposed changes may be otherwise explained; but we shall hereafter find sufficient evidence that they would have better consulted their own reputation if they had abstained from censuring his prejudices till they had at least in some places equalled the general faithfulness of his comparatively rude delineations. Schröter has recorded many other minute variations in the aspect of the interior level and the wall, which need not be referred to further than as indicating the desirableness of a more accurate study of similar details, for which this great ring seems conveniently situated. I regret to add that I have given but little attention to it, partly perhaps in consequence of its comparative want of elevation, which renders it a less conspicuous object than might have been expected at a moderate distance from the terminator. There are, however, two unusually deep craters on the N.W. side of the ring, whose shadows, if they were of greater breadth, would catch the eye strongly. The larger, or exterior one, which is marked *h* by Schröter, was twice measured by him at 9223 and 10,358 feet —a sufficient evidence, at any rate, of its enormous depth; the corresponding measures of his *i*, which is the smaller, are 9543 and 10,976 feet; fully justifying his remark, "What an extraordinary romantic prospect would not these two craters

exhibit to the human eye, if it could look down beneath it from the inner slope of their rings into such deep basins shaped by nature, and could see the day break in these natural mountain cauldrons, that in point of depth could receive our St. Gothard into them." These measurements are accepted by Lohrmann, but B. and M. do not even allude to this extraordinary depth, and have only thought the inner of the two craters worthy of a letter of reference (B).

This great ring-plain, and its subordinate members, afford an instructive instance of two leading facts pointed out by Schröter, and exemplified more or less in every part of the moon, that the lesser are in general the more recent eruptions, and that the smaller craters, when not actually deeper than their larger neighbours, as is frequently the case, are almost universally so in proportion to their aperture. These evident workings of general laws require the especial attention of every student who wishes to investigate the early history of the moon.

It is somewhat singular that Lohrmann has assigned a brightness of 9° (the maximum being 10°) to our central crater, *Posidonius* A, which B. and M. rate only as 6° to 7°. Had the observers not been nearly contemporary, we might have supposed some alteration in reflective power. B. and M. speak of two other points as reaching 7°, and therefore by inference exceeding A in brightness; the one, the deep crater B in the N.W. ring; the other, a summit on the ring where it abuts upon the adjacent smaller ring-plain *Posidonius* F, on its S.W. side. So little is really known respecting what may be called the *local colouring* of the lunar surface that landmarks of this kind are deserving of record and re-examination from time to time, and we are not without some reason, as will be seen hereafter, for believing that a careful investigation of this subject might meet with its reward.

The cavity *Posidonius* F, just mentioned, is distinguished by a minute crater in its centre; a position much more frequently occupied by a solitary peak, or group of small hills.

I have observed that Lohrmann has considerably exaggerated the size of a small crater (C in his notation—unlettered by B. and M.), lying at some distance E. from the N. end of *Posidonius*, in the *M. Serenitatis*. Too little care seems to have been in general taken in the delineation of small craters in the same neighbourhood according to their proportional size; it is to be hoped that future contributors to selenography will be more scrupulous as to this point, which only requires a moderate degree of attention, and a little caution not to be misled by any apparent enlargement of the ring near the terminator. It is only by means of carefully proportioned

drawings that we shall be able to ascertain whether any enlargement of existing craters is in progress at the present day. The extensive system of measurement which Mr. Birt has undertaken with so much spirit and energy will be most valuable in this respect.

It is not our intention to enter into speculations as to the origin of the present condition of the lunar surface; some inferences are, indeed, very obvious; still, on the whole sufficient materials have not been collected for any satisfactory generalization. But suggestions are always admissible, and sometimes useful; and it may therefore be remarked that the aspect of the partially-doubled and divergent rampart of *Posidonius* might be thought indicative of the intrusion of semi-fluid matter from beneath into a combination of two craters, one formed excentrically within the other.

OCCULTATIONS.

February 2nd.— σ Arietis, 6 mag., 11h. 57m. to 12h. 46m.—9th, 60 Cancri, 6 mag., 5h. 16m. to 6h. 16m.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

BY G. M. WHIPPLE.

1864.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		Rain- read a 9·30 A.M.
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated.			Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
			Dew Point.	Relative Humidity.	Tension of Vapour.						
	inches.	°	°		inch.	°	°	°			inches
Oct. 1	30·095	53·5	48·6	·85	·420	60·6	46·3	14·3	9, 9, 4	E by N, ESE, E by N.	0·00
„ 2	...	...	...	...	...	58·7	47·6	11·1	...	...	·02
„ 3	30·278	48·6	35·5	·63	·356	53·6	43·3	10·3	3, 1, 2	E, ESE, E by N.	·00
„ 4	30·132	47·0	36·8	·70	·337	51·6	42·7	8·9	0, 1, 6	E, E, E by N.	·00
„ 5	30·048	50·2	40·2	·71	·376	56·0	41·3	14·7	0, 0, 0	E, E by N, E.	·00
„ 6	30·155	51·7	41·3	·70	·395	59·0	36·9	22·1	0, 0, 5	E, E by S, E.	·00
„ 7	30·227	52·8	44·3	·74	·410	59·8	42·3	17·5	0, 0, 0	ENE, E, E by N.	·00
„ 8	30·214	52·2	44·1	·76	·402	59·9	37·4	22·5	2, 3, 7	E, ENE, E by N.	·00
„ 9	...	...	...	...	...	54·7	37·4	17·3	...	...	·00
„ 10	30·253	50·2	45·2	·84	·376	54·8	45·7	9·1	1, 10, 9	NE by N, NNE, N by E.	·03
„ 11	30·324	49·5	42·9	·80	·367	54·8	45·9	8·9	7, 10, 10	N, NW, NW.	·00
„ 12	30·249	52·4	42·3	·71	·405	57·7	47·5	10·2	10, 10, 10	NNW, NNW, NW by N.	·00
„ 13	30·076	51·4	41·6	·71	·391	55·2	49·5	5·7	10, 10, 10	NW, NW by N, NW.	·00
„ 14	30·038	51·5	46·6	·85	·393	56·6	44·1	12·5	10, 9, 10	WNW, NW, N.	·00
„ 15	30·117	47·4	38·3	·73	·341	53·5	38·7	14·8	0, 3, 8	NE by N, N, —.	·00
„ 16	...	...	...	...	...	56·7	45·2	11·5	...	...	·02
„ 17	29·664	52·4	50·7	·94	·405	59·1	49·3	9·8	8, 9, 9	SW, SW by W, WSW.	·01
„ 18	29·661	53·4	48·9	·86	·419	58·0	48·6	9·4	5, 9, 10	SW by W, W by N, SW by S.	·02
„ 19	29·197	60·7	54·6	·82	·535	65·6	45·1	20·5	1, 3, 7	S by E, S, S by E.	·00
„ 20	30·366	51·3	46·0	·84	·390	58·1	48·9	9·9	1, 5, 0	SW, SW, W by S.	·02
„ 21	29·417	50·0	44·3	·82	·373	56·2	41·4	14·8	9, 10, 9	ESE, ESE, ESE.	·00
„ 22	29·057	52·1	49·6	·92	·401	57·5	49·3	8·2	7, 8, 10	ESE, S by E, S by E.	·27
„ 23	...	...	...	...	...	54·6	48·7	5·9	...	...	·24
„ 24	29·379	49·3	40·5	·74	·364	56·5	35·7	20·8	6, 2, 1	—, SW, SW,	·00
„ 25	29·457	50·6	47·2	·89	·381	54·6	37·6	17·0	9, 10, 10	ENE, E, ENE.	·00
„ 26	29·291	52·1	50·8	·96	·401	55·5	49·0	6·5	10, 10, 10	E by N, NE by N, NE by N.	·00
„ 27	29·302	52·8	52·1	·98	·410	56·1	51·9	4·2	10, 10, 10	NW, SW by W, SW.	·55
„ 28	29·499	51·1	47·4	·88	·387	57·8	46·1	11·7	10, 3, 5	—, E, NE by E.	·02
„ 29	29·702	49·6	46·7	·90	·368	54·0	49·2	4·8	10, 10, 10	ENE, NE by E, NE by E.	·01
„ 30	...	...	...	...	...	48·3	46·5	1·8	...	...	·00
„ 31	30·181	42·9	36·1	·79	·292	48·0	41·0	7·0	7, 2, 0	E by N, E by S, ESE.	·00
Daily Means.	29·860	51·0	44·7	·81	·388	...	...	11·7	...	...	1·27

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—October, 1864.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																
A.M. 12	8	10	15	19	17	8	5	6	13	11	10	6	6	5	3	8	17	10	4	24	3	9	15	6	2	10	9	3		11	8	9·4
1	7	9	13	21	18	9	6	5	11	11	10	6	5	2	4	6	13	8	4	25	3	10	14	5	3	3	8	3		12	11	8·8
2	8	11	12	20	17	9	4	4	7	11	10	4	5	3	3	6	15	8	4	26	2	9	19	3	3	6	3	3		13	9	8·6
3	5	11	15	18		4	5	4	5	10	13	5	9	3	3	7	18	9	5	20	3	11	16	3	8	7	6	4		9	7	8·4
4	6	12	15	17		6	4	5	5	8	12	5	6	2	5	5	17	8	6	21	5	17	19	3	6	6	7	1		12	5	8·5
5	7	7	13	18		3	6	5	4	10	8	6	9	2	5	5	17	7	3	22	2	17	18	2	6	9	5	3		13	5	8·2
6	7	10	13	19	118	6	11	3	6	12	10	8	9	4	2	5	13	10	8	18	8	16	17	1	5	8	2	6		13	8	8·9
7	10	13	19	24		8	14	4	11	16	8	7	10	2	1	5	15	8	10	18	10	8	25	1	12	12	2	1		14	10	10·3
8	9	16	28	31		6	15	13	8	8	13	8	10	4	4	9	15	7	10	21	9	9	26	1	12	9	2	2		12	15	11·4
9	9	16	32	34		15	10	25	13	16	11	6	11	3	5	11	15	8	23	24	11	14	30	2	13	11	2	3		11	22	14·0
10	13	30	32	31	33	26	14	28	12	17	13	9	12	6	7	13	17	8	27	22	15	15	28	6	21	14	5		15	15	25	17·6
11	15	32	35	37	32	25	16	25	11	15	9	11	15	9	4	17	15	5	25	25	15	19	26	6	19	12	5		19	16	19	17·8
12	16	36	35	40	37	24	22	23	14	15	10	11	23	9	3	18	20	9	29	26	15	19	31	6	17	14	5		18	13	28	19·5
P.M. 1	21	34	34	39	38	27	23	22	11	15	9	11	12	6	3	19	18	5	28	25	19	19	25	5	18	10	7		20	12	25	18·7
2	20	31	35	42	35	29	22	20	14	12	11	7	11	8	3	15	16	5	28	27	21	20	26	6	18	11	6		21	14	29	18·8
3	17	29	36	37	36	25	20	19	10	13	10	7	11	5	2	18	11	6	21	21	22	18	25	6	20	11	6		21	15	26	17·4
4	15	34	31	30	31	24	18	21	7	10	12	8	11	2	0	20	10	5	22	22	23	23	20	4	17	11	7		18	13	17	16·2
5	14	30	27	27	26	22	15	20	8	6	8	4	7	2	4	17	10	4	17	12	22	22	18	1	20	11	4		15	12	10	13·8
6	9	30	21	25	24	18	17	17	10	6	8	7	5	1	3	18	10	5	16	8	20	21	15	0	18	13	3		17	14	10	12·9
7	10	30	21	25	13	20	14	22	10	5	8	9	4	2	4	17	10	7	17	9	24	18	18	1	18	13	5	322	18	16	12	13·3
8	10	30	18	23	5	18	12	15	7	10	7	6	3	1	6	15	6	4	15	5	21	19	11	1	14	11	9		15	13	8	11·2
9	12	30	17	20	7	20	10	11	8	8	7	7	3	4	6	15	10	4	18	8	18	17	11	1	15	10	6		14	11	12	11·3
10	11	28	24	23	5	16	9	12	8	9	6	4	5	6	7	15	12	5	23	4	19	14	8	2	17	9	4		14	12	11	11·4
11	9	17	20	17	6	8	6	13	9	6	8	7	3	4	8	15	12	1	26	2	10	13	8	2	12	7	6		12	9	9	9·5
12																																
Total Daily Movement.	268	536	561	637	498	376	298	342	222	260	231	169	205	95	95	299	332	156	389	435	320	377	469	74	314	238	124	588		305	341	12·8

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1864.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		Rain—read at 9.30 A.M.
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated. Dew Point.	Calculated. Relative Humidity.	Calculated. Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
	inches.	°	°		inch.	°	°	°			inches.
Nov. 1	30·193	44·8	34·1	·69	·312	48·2	39·8	8·4	5, 6, 10	E by S, ENE, ENE.	0·000
„ 2	30·146	43·8	34·0	·71	·301	46·3	41·2	5·1	8, 7, 9	NE, E by N, NE.	·000
„ 3	30·281	45·0	37·9	·78	·314	50·5	37·1	13·4	0, 3, 3	NE, NE, NE by N.	·000
„ 4	30·446	41·4	35·9	·82	·277	50·3	28·4	21·9	0, 0, 0	SW, —, —,	·000
„ 5	30·347	44·0	38·8	·84	·304	50·7	31·0	19·7	10, 7, 6	WSW, N, NE.	·000
„ 6	...	...	...	...	...	47·8	35·4	12·4	...	...	·011
„ 7	30·406	34·4	31·5	·90	·217	39·5	31·2	8·3	10, 9, 3	S by W, —, —.	·000
„ 8	30·118	38·6	35·7	·90	·251	45·1	27·1	18·0	10, 10, 10	SW by W, WSW, NNW.	·000
„ 9	30·149	42·3	32·9	·72	·286	46·7	33·5	13·2	5, 10, 10	NE, ENE, NE.	·000
„ 10	30·034	38·4	31·9	·79	·250	...	23·5	...	10, 0, 4	—, ENE, ENE.	·000
„ 11	29·917	34·7	31·4	·89	·219	38·8	27·4	11·4	10, 9, 10	SW, NNE, —.	·000
„ 12	29·786	37·9	34·1	·88	·245	43·0	31·1	11·9	10, 10, 10	ENE, SE by E, SE.	·000
„ 13	...	...	...	...	...	49·6	35·1	14·5	...	...	·010
„ 14	28·759	46·4	40·4	·81	·330	51·8	43·0	8·8	0, 4, 1	SW by S, SW by S, SW.	·290
„ 15	28·805	42·7	41·9	·97	·290	47·7	32·9	14·8	10, 9, 10	NE by E, NE, N by E.	·000
„ 16	29·369	44·0	40·4	·88	·304	47·2	37·0	10·2	10, 7, 10	WNW, WNW, W.	·010
„ 17	29·254	48·5	47·6	·97	·354	54·3	31·1	23·2	10, 10, 10	SSE, S by E, SW by S.	·069
„ 18	29·402	49·0	37·6	·67	·361	53·3	45·4	7·9	7, 10, 2	SW, W by S, WSW.	·160
„ 19	29·816	48·0	45·2	·91	·348	52·4	33·8	18·6	10, 9, 10	S by E, S by W, SSE.	·004
„ 20	...	...	...	...	...	53·1	44·2	8·9	...	...	·002
„ 21	29·863	43·7	43·0	·97	·300	52·1	36·1	16·0	10, 10, 6	SW, SW by S, S by W.	·013
„ 22	29·543	44·9	40·9	·87	·313	52·1	39·5	12·6	3, 9, 3	—, W by N, W.	·245
„ 23	29·610	42·7	39·4	·89	·290	46·2	36·3	9·9	7, 10, 10	S by W, S, SE by S.	·022
„ 24	29·253	38·3	35·3	·90	·249	40·7	35·0	5·7	10, 10, 10	W, SW, SSW.	·909
„ 25	29·303	40·3	35·4	·84	·267	45·7	25·1	20·6	9, 1, 10	SW, SSE, S.	·000
„ 26	29·090	40·6	34·4	·80	·270	45·0	26·4	18·6	3, 4, 3	WSW, WSW, W by S.	·140
„ 27	...	...	...	...	...	52·9	34·6	18·3	...	...	·004
„ 28	29·739	50·3	45·0	·83	·377	53·9	34·6	19·3	10, 10, 9	SSW, SW by S, SW by W.	·010
„ 29	30·364	40·4	36·5	·87	·268	46·9	34·6	12·3	0, 1, 0	SW, SW by S, S by E.	·031
„ 30	30·123	45·8	38·3	·77	·323	48·5	36·8	11·7	9, 10, 10	SW by S, S by W, SSW.	·007
Daily Means.	29·774	42·7	37·7	·84	·293	...	...	13·6	...	...	1·933

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—November, 1864.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hourly Means.
Hour.																															
12	11	13	7	1	4	10	5	4	3	4	5	9	8		2		1		7	17	2	16	11	15	3	15	9	15	8	7	7·9
A.M. 1	12	12	10	4	3	6	5	2	5	2	2	10	7		4		2		6	14	2	10	10	19	2	15	9	16	5	3	7·3
2	11	14	11	1	3	9	5	2	11	3	3	6	5		5		2		4	12	2	8	9	14	5	12	8	17	8	10	7·4
3	11	13	13	4	3	11	5	1	11	1	1	5	5		2		4		4	12	2	5	6	13	2	13	10	16	6	12	7·0
4	6	13	11	1	5	11	3	1	6	1	1	2	6		2		5	608	3	10	2	10	5	17	2	14	10	16	7	15	6·9
5	7	15	10	1	6	12	2	1	2	3	3	1	6		2		8		2	8	1	10	12	16	1	12	12	18	9	17	7·3
6	10	12	8	3	5	9	1	3	6	1	0	1	8		5		9		3	7	1	8	12	20	0	11	9	11	10	23	7·3
7	11	9	7	2	4	11	2	1	3	3	1	2	10		3		10		3	13	0	11	9	18	1	11	9	20	10	21	7·6
8	14	18	6	4	4	10	2	1	2	2	2	2	15		5		10		2	12	1	8	8	20	0	10	9	24	9	24	8·3
9	23	15	9	4	4	11	3	4	6	1	2	3	13		5		15		8	13	2	10	9	17	2	8	8	24	10	27	9·5
10	28	18	7	3	3	14	2	6	15	2	5	2		22	5	7	21	33	15	15	1	16	8	18	2	12	8	24	10	32	12·2
11	26	19	15	4	7	13	3	2	15	5	2	5		20		7	22	34	13	12	3	14	14	17	5	18	11	27	6	27	13·1
12	29	20	12	4	13	20	2	2	10	21	2	4		21		8	21	32	13	10	2	14	10	16	11	15	11	25	7	31	13·8
P.M. 1	27	20	10	4	14	20	0	2	7	24	2	3		19		8	24	30	14	7	6	9	7	11	12	15	8	26	8	35	13·3
2	21	15	8	4	16	15	0	4	12	16	2	3		17		11	21	25	15	13	10	9	7	10	12	14	7	23	7	30	12·4
3	24	13	6	3	14	15	1	1	9	14	2	2		13		5	22	24	15	10	10	10	6	10	14	15	6	26	6	30	11·6
4	18	13	3	2	9	13	2	3	8	13	1	3		8		6	23	19	15	11	9	15	6	10	21	15	6	24	6	29	11·1
5	17	11	3	1	8	9	1	8	6	10	1	5		7		2	19	18	11	12	7	15	5	10	20	11	10	22	8	29	10·2
6	15	13	3	3	9	8	1	9	8	7	2	5		10		4		15	15	6	10	13	9	7	29	12	9	25	7	31	10·5
7	15	15	2	4	9	10	1	6	9	10	2	4		10		4		12	11	6	12	15	5	6	34	12	10	20	5	23	10·1
8	11	13	2	2	10	8	0	9	6	5	2	6		7		3		13	8	5	12	13	6	5	33	10	16	15	5	11	8·8
9	12	10	2	3	8	7	1	4	2	1	2	5	328	6	202	3		14	16	9	14	14	9	3	28	12	19	11	8	9	8·6
10	13	10	1	5	13	6	2	7	3	4	2	10		5		3		13	17	9	17	14	9	4	21	13	21	10	6	8	9·1
11	14	10	4	2	13	4	2	6	2	4	1	10		5		1		12	17	5	16	11	12	5	15	10	20	12	7	10	8·5
12																															
Total Daily Movement.	386	334	170	69	187	262	51	89	167	157	48	104	581		314		1141		237	248	144	278	204	301	275	306	255	467	178	494	10·3

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1864. Day of Month.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2·30 P.M., and 5 P.M. respectively.		Rain—read at 9·30 A.M.
	Barometer, corrected to Temp. 32°*	Temperature of Air.	Calculated.			Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
			Dew Point.	Relative Humidity.	Tension of Vapour.						
	inches.	°	°		inch.	°	°	°			inches.
Dec. 1	30·168	41·8	39·3	·91	·281	47·3	31·3	16·0	1, 0, 0	SW, SW, SSW.	0·254
„ 2	30·391	35·1	33·8	·96	·222	47·2	26·5	20·7	10, 7, 0	—, —, S.	·000
„ 3	30·334	47·4	44·7	·91	·341	49·6	33·7	15·9	10, 9, 10	S by W, SSW, —.	·010
„ 4	...	...	...	...	...	48·8	44·0	4·8	...	...	·008
„ 5	30·046	48·2	36·7	·67	·351	52·8	44·5	8·3	6, 0, 0	SW, S by W, S.	·000
„ 6	30·003	47·3	45·6	·94	·340	51·2	42·9	8·3	9, 6, 2	SW, W by S, SW.	·000
„ 7	29·864	46·7	44·6	·93	·333	48·7	35·0	13·7	10, 10, 10	S, S by W, SSW.	·004
„ 8	29·657	43·7	41·1	·91	·300	46·7	44·9	1·8	10, 7, 7	SSE, SW, S by W.	·040
„ 9	29·817	44·1	41·4	·91	·305	47·4	27·9	19·5	10, 3, 3	—, S by W, S by E.	·027
„ 10	29·838	39·9	38·1	·94	·263	45·0	38·7	6·3	3, 8, 0	E, SSE, NE.	·010
„ 11	...	...	...	...	...	50·2	30·0	20·2	...	...	·008
„ 12	29·496	45·5	42·4	·90	·320	48·6	44·5	4·1	8, 10, 4	SE by S, S by E, SW.	·000
„ 13	29·543	42·8	42·0	·97	·291	46·0	32·9	13·1	10, 10, 10	NE, E by N, E.	·030
„ 14	29·774	40·1	36·5	·88	·265	41·2	37·3	3·9	10, 10, 10	ENE, NE by E, NE.	·003
„ 15	29·742	33·4	28·8	·85	·209	35·1	33·1	2·0	10, 10, 10	NE by E, NE, NE.	·000
„ 16	29·822	32·6	30·0	·91	·203	35·3	33·0	2·3	10, 10, 10	ENE, E by N, ENE.	·000
„ 17	29·814	28·2	23·1	·83	·174	31·0	27·0	4·0	10, 8, 10	NE, NE by E, N.	·000
„ 18	...	...	...	...	...	37·1	16·3	20·8	...	...	†·025
„ 19	29·924	36·9	33·7	·89	·237	44·4	26·1	18·3	4, 6, 10	—, SE by E, SE.	†·026
„ 20	29·848	44·0	42·4	·94	·304	47·7	30·4	17·3	10, 6, 10	SE, E by S, E by N.	·033
„ 21	29·969	39·1	36·0	·90	·256	40·7	39·1	1·6	10, 10, 10	WSW, SW by W, NW.	·010
„ 22	30·204	33·9	29·6	·86	·213	35·8	35·0	0·8	10, 10, 10	ENE, NNE, NE.	·000
„ 23	30·430	31·7	26·8	·84	·197	33·2	30·5	2·7	9, 10, 10	E, ENE, ENE.	·000
„ 24	30·555	30·7	26·8	·87	·190	33·1	26·6	6·5	9, 10, 10	NE by E, NE, NE by N.	·000
„ 25	...	...	...	...	...	34·3	30·3	4·0	...	...	·000
„ 26	...	...	...	...	...	37·1	32·4	4·7	...	...	·000
„ 27	30·309	32·5	26·7	·81	·203	35·7	27·8	7·9	1, 9, 10	NW, —, NNW.	·000
„ 28	30·341	38·1	34·0	·87	·247	42·6	28·8	13·8	3, 7, 10	SW, W, W by S.	·000
„ 29	30·329	40·8	36·5	·86	·271	42·7	32·1	10·6	10, 10, 10	NW by N, SW, SW.	·000
„ 30	29·941	38·0	34·2	·87	·246	40·0	38·3	1·7	10, 10, 10	SW by S, SW, SW by S.	·000
„ 31	29·824	34·5	31·6	·90	·218	36·9	30·5	6·4	9, 10, 10	NE, ENE, ENE.	·001
Daily Means.	30·000	39·1	35·6	·89	·261	...	...	9·1	...	... ...	0·489

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch. † Rain and melted snow.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—December, 1864.

Day.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																	
12		7	2	6	20	10	7		20	5	8	1	15	8	15	22	8	8	2	10	15	5	17	25	18	14	17	6	5	2	6	2	10·2
1	A.M.	5	1	6	18	14	7		16	4	6	1	15	9	17	19	12	7	5	6	18	1	15	28	17	14	16	6	3	4	2	3	9·8
2	A.M.	3	2	9	17	11	10		20	1	9	4	15	8	11	19	13	3	7	5	18	1	15	23	14	12	12	6	4	2	3	1	9·3
3	A.M.	2	2	6	16	15	9		19	2	7	2	13	12	9	21	6	7	8	4	14	3	18	24	14	16	11	7	4	4	2	7	9·5
4	A.M.	4	1	9	16	13	10		18	2	8	3	16	13	9	15	9	6	13	5	18	2	20	23	16	16	15	9	2	4	0	7	10·1
5	A.M.	5	1	10	17	13	9	48	20	2	10	2	14	11	9	20	12	5	20	7	13	3	22	15	15	13	15	7	2	4	1	8	10·2
6	A.M.	3	3	10	16	9	5		20	1	9	5	15	4	7	21	13	4	11	6	11	3	20	28	22	16	10	9	5	4	1	10	10·0
7	A.M.	4	1	10	13	11	6		19	1	7	9	17	5	13	21	20	6	10	8	8	4	26	30	22	18	14	7	7	5	1	7	11·0
8	A.M.	4	2	13	17	14	5		19	1	5	11	17	3	10	16	15	11	8	3	8	4	29	37	25	16	12	6	5	4	4	5	10·9
9	A.M.	5	2	10	17	13	5		22	1	14	11	14	7	9	19	22	14	16	2	5	4	23	32	20	15	9	4	5	4	5	4	11·1
10	A.M.	6	1	18	16	13	8		20	0	7	14	20	12	11	19	26	15	17	1	7	6	21	33	21	15	8	3	4	5	8	5	12·0
11	A.M.	6	2	15	18	15	7		13	1	9	18	20	13	14	17	28	13	14	2	9	7	23	22	22	15	8	3	6	5	10	8	12·1
12		6	3	13	16	15	5		10	1	6	18	18	13	13	14	24	15	7	2	7	11	22	29	21	15	11	2	7	5	9	7	11·5
1	P.M.	6	4	19	20	19	5		8	9	9	20	17	13	12	13	29	9	6	6	7	12	19	29	19	15	9	5	5	8	6	10	12·3
2	P.M.	5	1	18	18	15	5	103	7	6	6	20	17	13	12	12	26	6	4	6	5	9	18	25	15	11	10	4	5	7	9	8	10·8
3	P.M.	5	2	15	15	15	3		6	9	5	18	13	10	18	14	26	6	7	3	9	12	19	28	17	12	9	4	7	8	9	10	11·1
4	P.M.	7	5	20	18	13	5		5	9	4	19	13	9	14	13	26	3	9	5	7	13	21	32	16	12	10	3	3	7	6	9	11·2
5	P.M.	6	4	15	11	15	3		5	7	4	17	9	10	15	14	25	4	11	7	4	14	20	19	19	11	10	3	5	6	4	12	10·3
6	P.M.	5	3	18	11	12	4	15	2	5	1	23	5	8	12	12	23	3	11	8	2	24	21	24	20	14	9	1	4	7	6	14	10·6
7	P.M.	2	2	17	14	10	2	14	4	3	4	19	5	12	19	13	22	5	12	7	6	22	22	23	18	18	11	2	4	7	6	12	10·9
8	P.M.	3	2	15	16	8	2	12	5	3	3	20	5	10	18	15	15	2	10	8	7	23	31	22	19	16	7	3	2	5	8	11	10·5
9	P.M.	3	1	20	14	7	1	17	4	7	3	19	3	9	15	12	10	3	9	13	2	21	31	19	17	16	6	4	3	5	4	9	9·9
10	P.M.	3	5	19	13	14	1	21	3	8	2	25	3	9	11	9	17	1	9	13	1	19	30	20	16	18	6	5	2	2	3	10	10·3
11	P.M.	2	6	15	12	8	1	20	4	10	3	17	7	12	16	6	12	3	11	14	2	20	30	17	15	14	6	4	4	4	4	9	10·0
12																																	
Total Daily Movement.		107	58	326	379	302	125	250	289	98	149	316	306	233	309	376	439	159	237	151	203	249	533	607	438	352	251	113	103	119	117	188	10·6

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

MONTHLY AND ANNUAL MEANS FOR THE YEAR 1864.

Month.	Barometer, corrected to temp. 32.°	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Daily Range.	Total Fall of Rain.	Month.	Barometer, corrected to temp. 32.°	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Daily Range.	Total Fall of Rain.
	inches.	°	°		inch.	°	inches.		inches.	°	°		inch.	°	inches.
January	30·184	36·8	33·7	·81	·220	9·0	0·957	August ...	30·053	60·7	45·4	·61	·546	20·7	1·268
February ...	29·918	36·4	32·7	·87	·209	9·7	0·729	September.	29·917	57·1	49·0	·76	·477	15·4	2·500
March.....	29·655	41·2	35·8	·83	·231	13·8	2·640	October ...	29·860	51·0	44·7	·81	·388	11·7	1·277
April	30·057	48·5	37·4	·69	·363	19·2	0·866	November .	29 774	42·7	37·7	·84	·293	13·6	1·938
May.....	29·979	54·0	44·3	·73	·441	20·5	1·579	December..	30·000	39·1	35·6	·89	·261	9·1	0·489
June	29·930	56·3	45·6	·70	·465	17·2	2·064								
July.....	30·000	62·2	48·6	·64	·570	20·7	0·671	Mean	29·944	48·8	40·9	·76	·372	15·0	16·978

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

TABLE SHOWING THE MEAN VELOCITY OF THE WIND FOR EACH HOUR OF THE DAY IN THE DIFFERENT MONTHS OF THE YEAR 1864 (IN MILES PER HOUR).

	A. M.												P. M.												
Hour.	12 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	to 1	to 2	to 3	to 4	to 5	to 6	to 7	to 8	to 9	to 10	to 11	to 12	Mean.
Jan.	9·6	9·5	9·5	9·7	10·5	10·0	10·4	10·2	9·1	9·6	10·7	11·0	11·5	11·9	11·7	11·3	10·3	9·1	9·4	9·5	8·4	8·9	8·9	8·7	9·9
Feb.	10·5	10·0	10·1	11·3	11·0	10·5	10·8	11·5	11·9	12·0	13·9	14·0	14·5	14·9	14·6	13·4	13·7	11·2	11·0	10·9	10·0	10·3	10·6	9·9	11·7
March ...	10·6	10·2	10·1	10·4	11·3	10·7	10·7	11·6	13·0	14·0	15·7	17·2	18·7	18·1	18·4	17·1	17·1	15·6	14·6	13·6	13·4	12·6	12·8	11·7	13·7
April.	7·6	7·6	6·7	7·1	7·5	7·0	8·2	9·2	10·9	11·1	11·7	12·0	13·5	13·1	13·4	12·8	13·6	11·9	10·6	10·0	9·3	9·1	9·7	7·8	10·0
May	6·3	5·2	4·7	4·8	4·8	4·6	6·8	8·2	9·1	9·5	10·1	11·1	12·2	11·6	11·7	11·9	11·0	10·7	8·6	8·0	6·8	7·0	7·0	7·0	8·8
June.....	7·9	7·2	6·9	6·3	7·2	7·5	9·2	10·6	10·6	11·2	11·6	11·9	13·1	12·9	13·4	13·4	13·8	12·9	11·7	10·1	8·8	8·1	9·4	7·4	10·0
July	6·2	6·5	6·3	6·4	6·4	6·6	8·0	9·4	10·1	10·4	12·4	12·7	13·7	14·0	14·1	14·4	14·8	13·2	11·8	10·7	8·8	8·8	8·3	7·0	10·0
August...	5·9	6·1	5·4	5·3	5·4	5·6	6·7	8·0	9·1	10·1	10·5	11·3	11·1	10·9	11·1	11·5	12·2	11·7	10·0	8·9	7·1	7·1	6·8	5·6	8·5
Sept.	7·5	7·6	6·9	6·8	6·7	7·2	7·2	8·6	10·3	11·8	13·0	13·0	13·3	14·0	14·3	13·2	13·2	10·4	8·9	8·9	7·4	7·3	8·3	7·4	9·1
Oct.	9·4	8·8	8·6	8·4	8·5	8·2	8·9	10·3	11·4	14·0	17·6	17·8	19·5	18·7	18·8	17·4	16·2	13·8	12·9	13·3	11·2	11·3	11·4	9·5	12·8
Nov.....	7·9	7·3	7·4	7·0	6·9	7·3	7·3	7·6	8·3	9·5	12·2	13·1	13·8	13·3	12·4	11·6	11·1	10·2	10·5	10·1	8·8	8·6	9·1	8·5	10·3
Dec.	10·0	9·8	9·3	9·5	10·1	10·2	10·0	11·0	10·9	11·1	12·0	12·1	11·5	12·3	10·8	11·1	11·2	10·3	10·6	10·9	10·5	9·9	10·3	10·0	10·6
Mean.....	8·3	8·0	7·7	7·8	8·0	7·9	8·7	9·7	10·4	11·2	12·6	13·1	13·9	13·8	13·7	13·3	13·2	11·7	10·9	10·4	9·2	9·1	9·4	8·4	10·4

THE "POPULAR MICROSCOPE."

UNDER this title, Messrs. Smith, Beck, and Beck have introduced an instrument exhibiting more useful novelties in construction than have appeared in any other microscope for a long time. In point of rank, the "Popular Microscope" is intended to take its place between the most simple and the most elaborate patterns. It is devised for those who require more than can be obtained in the various instruments now offered for about five pounds, and who from choice or economy wish to stop far short of the large price which the best makers all charge for their first-class work.

We never undertake to offer any opinion on the purely commercial question of which optician offers the most for a given sum of money. Whenever a new microscope appears, we desire to make our readers acquainted with its peculiarities, and we only feel justified in noticing instruments that differ in some important particular from what has been previously produced.

The requirements of the public are so various that they can only be met by the exertions of a variety of manufacturers directed in somewhat different ways. One microscopist will have a handsome-looking instrument at a low price, and he must be contented with inferiority in the optical work; another will put up with an ugly and even awkward stand, if better glasses accompany it; a third wishes for glasses that divide into lower powers on account of their economy, and he must be content to have less perfection than can be obtained by the purchase of objectives made on a different plan. Even when money is plentiful, and the student is willing to give a hundred guineas or more for an instrument, he will still find that whichever pattern he chooses, he goes without some advantage that another pattern may possess. It is only just to various makers that these facts should be insisted upon, and it is for our readers to form their own opinion of the extent to which the changes introduced by Messrs. Smith, Beck, and Beck are likely to meet their own peculiar requirements.

The first thing that strikes an observer of the "Popular Microscope" is the new mode of adjusting it to any angle between a horizontal and a perpendicular position. On reference to the annexed sketch, it will be seen that the base is a triangular frame, down the middle of which are four holes, a pin L, and an upright K having a hole, shown by the dark spot at the top. The tube carrying the body of the instrument is attached by a pivot to a broad stay, G, and the bottom of this stay is hinged on to the base, F. At the

bottom of the tube H is a pin that fits into any of the holes in the base. If this pin is inserted into the hole near L, the instrument is held upright or vertical. If into the hole at the top of the little support, K, it is horizontal, as shown in Figure 2.* The other holes permit it to be adjusted in intermediate positions. The mechanical effect of this arrangement is to give great stability with very little weight. The coarse and fine adjustments, O, O, and P, need no explanation.

In the construction of the two stages supplied with this instrument, much ingenuity has been usefully exercised. One of these stages is intended for finger movements, the other has mechanical motions on an entirely new plan. Both stages are circular. They fit on to a short stout piece of tube, and can be rotated with slight pressure. It appears to us that this plan, with mechanical arrangements for rotation, might be adapted with advantage to first-class instruments. It is compatible (as in the Popular Microscope) with a thin stage and a large central aperture, facilitating the use of oblique light. The object-holder is attached to the under surface of the stage by a simple circular spring, and holds it down with a force that is easily regulated by two screws. By this means the pleasant smooth resistance afforded by the magnetic stage

* The page containing Fig. 2 must be turned sideways, to bring the figure right.

is obtained without the uncertainty that is inseparable from the magnetic pattern.

The mechanical stage is quite new and very simple. It has the usual quick movements, and the slow ones are regulated by two milled heads working on concentric spindles, as in Powell and Lealand's pattern. One of these spindles has a friction hold upon a plate, which it carries up or down, while the second spindle pulls the first backwards or forwards horizontally, and the moveable plate is so attached as to go with it. This again is an arrangement that looks likely to work well with first-class instruments. It is simpler than the ordinary plan, and does not add so much to the thickness of the stage.

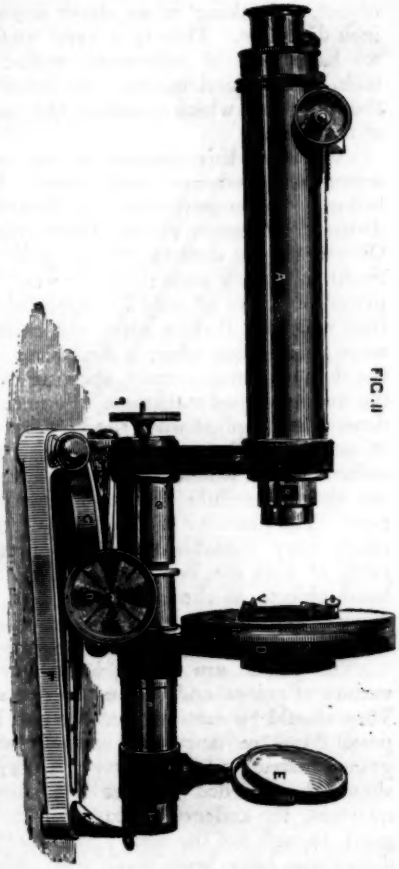


FIG. 11.

The "Popular Microscope" is fitted to carry most of the apparatus that advanced students will require, and a set of small angled, but fairly corrected, objectives are made expressly for it. The makers observe that "there are many persons who would not with ordinary objects, and using only the first and second eye-pieces, see any difference between these powers and the very best." They add that, "with very severe tests, and employing the third or higher eye-pieces, the difference is very perceptible; but many who work with the microscope never require the highest class of performance." Small angled glasses are well

adapted for binocular use, and as the "Popular Microscope" has the universal screw, it will carry any of the more expensive and first-class objectives that might be desired.

The microscope before us is supplied with a single combination focussing rather more than three inches from the object, and taking in an object more than three-eighths of an inch diameter. This is a very useful power, and the lowest we have seen of achromatic make. Then there is a good inch, and a good quarter, the latter working very fairly with the binocular, which is seldom the case with low-priced glasses of that focus.

We tried this quarter on our own instrument, using an achromatic condenser with stops. With our third eye-piece, bringing the magnification to about 600 linear, we obtained a distinct resolution of the *Pleurosigma angulatum* into dots. Of course the defects of the glass were shown, as Messrs. Smith and Beck state; but we were surprised to find a low-priced objective of only 75° aperture do so much. A similar trial with the Podura scale was equally effective. There was more colour than when a first-class quarter is employed, but the definition was correct, showing even the spots of light on the wedge-shaped markings. We notice that an achromatic condenser is supplied with the Popular Microscope, but it is not of much use, for want of stops. Two stops would be quite sufficient, and would only add a few shillings to the expense; one should exclude the central, and the other the marginal rays. The plurality of stops in expensive condensers is certainly very valuable for special niceties; but the great majority of work can be done with two, one adapted to show such lined objects as the *angulatum*, and the other fitted for the general examination of objects in which penetration is needed, and the marginal rays are better shut out.

The public are now able to buy microscopes at a great variety of prices and various proportionable degrees of merit. They should be cautioned on the one hand not to expect impossibilities, or fancy that anybody will give them a hundred guinea instrument for twenty pounds; and on the other they should be guarded against a tendency, prevalent in some quarters, to undervalue instruments that are substantially good, though not the *best*. Nine-tenths of the most important discoveries have been made with objectives much worse than those which respectable opticians now supply as avowedly second-rate; and it is only after long practice, and when a large amount of information has been acquired, that the finest glasses became more useful to students than those which, being only a little below them in quality, can be had for half the price.

The workmanship of the Popular Microscope is excellent. Messrs. Smith, Beck, and Beck have wisely determined that their lower priced instruments shall not be stinted in *quality* of work, and we have no doubt the public will approve of this decision.

ARCHÆOLOGIA.

We have in our hands the newly published *livraison*, vol. vi., part 2, of Mr. Roach Smith's *Collectanea Antiqua*, a series of etchings of ancient remains, illustrative of the habits, customs, and history of past ages, and, we may add, accompanied by extremely valuable essays on the objects represented in the plates. This interesting work is, unfortunately, almost inaccessible to the general reader. It appears only at intervals, and is not printed for public sale, but exclusively for a small number of subscribers, so that it becomes immediately after its publication a rare book. A set from the commencement, when it does accidentally occur for sale, is eagerly purchased for a very large price. This is the more to be regretted, as Mr. Roach Smith's *Collectanea Antiqua* is, we have no hesitation in saying, the most valuable collection of antiquarian essays and antiquarian information in existence. To those who are favoured with the possession of it, each new number brings a really rich contribution of archæological facts, as may well be expected from the long experience and activity of its author; and the present number is very far from being an exception, for it contains several papers of unusual interest. In one of these Mr. Smith has brought together accounts of researches made recently among Anglo-Saxon cemeteries, in five different localities—Faversham and Sarre, in Kent; Chessell Down, in the Isle of Wight; Barrington, in Cambridgeshire; and Kempston, near Bedford. These cemeteries were nearly all discovered by mere accident. That at Faversham lay in the line of cutting for the London, Chatham, and Dover Railway, and the numerous and very remarkable objects found in it are now in the possession of W. Gibbs, Esq., of that place. That at Barrington was brought to light during the process of land drainage, and that at Kempston was dug into in the course of digging a gravel-pit. They belong to at least two different branches of the Anglo-Saxon family, for the cemeteries at Barrington and Kempston were, of course, Anglian burial places, while those found in Kent belonged to the Jutes, who, according to the early Anglo-Saxon historians, formed the population of that part of England. The difference in form and design of the principal personal ornaments found in these different sets of graves seems to show that each branch of the race—Angles, or Jutes, or Saxons—wore a distinctive costume, at least during the earlier period of their history, so that the nationality of the individual would be at once apparent by his dress. This is only

one among many particulars in which the objects found in these cemeteries throw light upon the obscurities of the early history of our fathers, and as they are further excavated, the light will become continually greater as the multitude of facts for comparison increases. The objects found in the Isle of Wight bear so close a resemblance to those found in the Kentish graves, that we cannot but consider them as confirming the statement of Bede, though it has been contradicted by some antiquaries, that that island was inhabited by the same Jutish race who formed the population of Kent.

One of the rather numerous plates of Anglo-Saxon antiquities here given by Mr. Roach Smith represents the contents of a grave in the Isle of Wight, just as they lay when discovered. It was that of a lady, who, in life, had evidently been "of stately presence." Round her neck had been hung a rather long string of beads, varied in form and design, and many of them very beautiful. She appears to have worn a robe, which was fastened at the breast by three large fibulæ of silver (of a form which is found commonly, though of different material, among the Anglian graves), arranged one above the other. Over the robe a mantle appears to have been worn, probably open in front, for it had been fastened at the right shoulder by a fine large round fibula, and on the left shoulder by a fibula of a different shape, but equally ornamental. At the waist a buckle indicated the place of the girdle, and near it lay a knife, which had, perhaps, been placed in a case attached to the girdle. Between the legs were two objects which appeared also to have been suspended to the girdle, and probably hung rather lower than the knees. One of these objects was a large spoon of silver gilt, the bowl of which was perforated with five holes; the other was a ball of dark-coloured crystal, enclosed in silver mountings. The use of either of these articles is not very evident. There are some reasons for believing that in these early times a ball of crystal attached in any way to the person was looked upon as a sign of authority or power, but Mr. Smith seems inclined to reject this interpretation. At the lady's feet had been deposited a bronze pail and two buckets. The little finger of her right hand wore a massive gold ring, beautifully chased, and on the same finger of the other hand there was a spiral ring of silver. Close to the left arm, and parallel to it, lay a key-shaped object made of iron; and in a similar position on the other side of the body another implement of the same metal, formed like a sword, but quite blunt at the edges, and narrowing off into a long point at the end. The handle was close by, and perhaps in, the hand. A cloth fringed with gold tissue had been thrown over the head and face. Altogether, the costume must have been very rich and handsome.

Another excellent paper in this number of the *Collectanea Antiqua* is devoted to the subject of "Remains of Roman Potteries on the banks of the Medway and the Nen, and in London." In an essay on the "Archæology of Horticulture," continued from the previous number, Mr. Roach Smith has collected a far larger quantity of evidence, much of it extremely curious, on the cultivation of the grape for wine in our island, and has shown most satisfactorily

that in former times wine was commonly made in England. The subjects of the other papers are all Roman. There was a town in ancient Egypt named Babylon, which is pretended to have been founded by Babylonian captives, but it was fortified by the Romans, and made the head-quarters of one of the legions. It became in the middle ages the capital of the Egyptian khalifs, and a place of great commercial importance, and has been sometimes confounded with the more celebrated Babylon in Assyria. Its site is commonly called Old Cairo, and is remarkable for the fine remains of Roman building which are still seen there. These are here represented in some spirited etchings by Mr. Fairholt, from drawings made by him on a recent visit. Another paper describes the Roman villa recently discovered at Carisbrooke, in the Isle of Wight, with views and plans, and an engraving of the very elegant tesselated pavement which formed the floor of one of the rooms; and in another, Mr. Roach Smith has brought before the notice of antiquaries a new class of antiquities, Roman leaden seals, which have been found in rather considerable quantities on the site of the Roman *Verteræ*, at Brough-upon-Stanmore, in Westmoreland. If found elsewhere, they are excessively rare, and it is very difficult to say what was their particular use, except that they have many of them holes which were evidently designed for attaching them to some object which they were intended to authenticate. Perhaps there may have been here an official dépôt for such objects, where th seals were taken off. Many of them have inscriptions, some containing the name and number of a military legion or cohort, and others apparently the names of individuals. Some of them have figures resembling those found on coins and gems. The only contribution to our archæological knowledge in this number of the *Collectanea* which remains to be noticed, consists of two plates of rare coins of the Emperor Carausius, which are supplementary to an article on the same subject given in a preceding volume. We need hardly point out the great interest the coins of this usurper have for the history of Roman Britain.

The excavations at Silchester, on the site of the Roman city of *Calleva*, carried on at the expense of the Duke of Wellington, the lord of the soil, have not, as far as our last information goes, produced any very interesting results, beyond the discovery of the foundations of houses and floors. The latter, though belonging to rather large rooms, appear, as far as they have been hitherto uncovered, to have belonged to houses of a class not very highly decorated. The greater number were paved merely with the common red tessellæ, but in some the pavement was formed of white and red tessellæ alternately, and one only had a richer tesselated pavement, with a central ornament, which had been nearly destroyed at some former period, radiating from which were found portions of white tessellæ, forming a stellated pattern. The coins found are few, and only of common types, including examples of Gratian, Constantine, Allectus, and Carausius.

Interesting discoveries have recently been made on the site of a Roman settlement at Southfleet, in Kent, supposed to belong to

the town of *Vagniacæ*, marked in the Roman itineraries as lying on the great Watling Street road somewhere in this neighbourhood. Frequent discoveries of Roman remains have been made at this place during many years, which tend to show that it must have been a town of considerable importance. Various objects lately found there were exhibited at a recent meeting of the Archæological Institute, including a richly jewelled necklace of gold, with rings and bracelets of the same material, found in a stone coffin with the skeletons of two young children; and two previously unknown British coins in bronze, one of which bears the figure of an elephant. We may remark that the discovery of British coins under such circumstances is not necessarily a proof of the early date of the settlement, as British and Gaulish coins were certainly in circulation during a considerable part of the Roman period.

An interesting discovery has been made at Northwich, in Cheshire, where the Romans had considerable salt-works. While excavating for graving docks on the banks of the river Weaver, the workmen came upon four leaden pans, which had been used by the Romans for extracting brine from the natural salt. They were found at a depth of about ten feet. The workmen broke up three of these vessels and sold them for old metal, but the fourth was preserved, and is now in the Warrington Museum. It is a square vessel, about three feet and a half long by two feet and a quarter wide, and four and a half inches deep. At each end there is a hole in the side, believed to have been intended for the purpose of fixing it to a wooden framework, and the inner surface of the bottom is covered with scratches, supposed to have been made by the teeth of a rake, used for removing the dross deposited in the process of evaporation. On one side there are marks of letters, which have not been satisfactorily deciphered. On a fragment of one of the other pans an inscription has been traced which seems to be correctly read as DEVAE, which was the Roman name for Chester, and has been conjectured to mean that the Roman salt-works at Northwich belonged to that city. But this does not appear to us to be a very probable interpretation. T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

ROYAL SOCIETY.—*Dec.* 15.

On the Production of Sugar in Animals by Cold.—Dr. Bence Jones read a paper detailing the production of sugar in the fluids of the animal body by extreme cold, attributing its formation to deficient oxidation of the carbonaceous articles of food. For example, a grain of starch enters into the body, and is transformed into sugar; it is then acted on by oxygen, and ultimately passes out as carbonic acid and water. This is the final result of the perfect combustion; but if the oxidation stops at any stage, imperfect combustion occurs.

The combustion may be made imperfect in at least three different ways. First, by insufficient oxygen; secondly, by overwhelming fuel; thirdly, by reducing the temperature so low that chemical action is checked. From each of these causes the following scale of the combustion of starch in the body may be formed:—When there is perfect combustion, then carbonic acid and water are produced. With less perfect combustion, oxalic and other vegetable acids are formed. With the least possible combustion, sugar results. Between perfect combustion and the most imperfect combustion—that is, between carbonic acid and sugar—there are probably many steps formed by many different acids; and as in a furnace one portion of the coal may be fully burnt, whilst other portions are passing through much less perfect combustion or are not burnt at all, so different portions of starch may reach different steps in the scale of combustion, and sugar, acetic acid, oxalic acid, carbonic acid, and many other acids between acetic and oxalic acid, may be simultaneously produced. From this account of the oxidation of starch, it follows that sugar should always be found in the urine whenever any of the three causes mentioned reduce the oxidation in the system to its minimum. In other words, by stopping the combustion that occurs in the body, diabetes should be produced artificially.

ETHNOLOGICAL SOCIETY.—*Dec.* 27.

The Hairy Men of Yesso.—A paper descriptive of the hairy people of the Island of Yesso was read by Mr. Martin Wood. Yesso, which is inhabited in the southern portion only by the Japanese, has an infertile soil and dreary climate. Its northern parts are inhabited by the Mosinos, or "all hairy people" of the Japanese, who number about 100,000, and dwell principally in two large cities, Mato-mai and Hako-dadi. These people are short, thick-set, and muscular, but clumsy and uncouth in their movements. In appearance they are wild and repulsive, in consequence

of the enormous amount of hair with which they are covered. The hair on the scalp forms a matted mass of gigantic size, their beards are long and thick, growing from the greater part of the face, and the whole of their bodies is covered with an extraordinary profusion of hair.

The women stain that part of the face which is covered by the beard in males. The skin, when not bronzed by exposure, is somewhat paler in colour than that of the Japanese.

These people, though timid from long subjugation to the Japanese, and isolation from the rest of the world, appear intelligent and lively. They have well-developed prominent foreheads and dark expressive eyes.

Their legends go back to a time previous to their having been subjected by the Japanese, probably several centuries before the Christian era.

ROYAL GEOGRAPHICAL SOCIETY.—*Jan.* 9.

THE ANCIENT REMAINS NEAR THE SOURCES OF THE TIGRIS.—Mr. J. C. Taylor, consul at Diarbekr, described several ancient remains he had discovered near the sources of the Tigris. The most interesting were two Assyrian inscriptions near the principal source of the Tigris. One of these belongs to Tiglath-Pileser I., who reigned about B.C. 1110, and the other to Ashur-izir-pal (the king of the Nimroud monolith), who dates about B.C. 880. The fact that such memorials had been placed in the situation where they had been found, by those monarchs during their northern expeditions, had been ascertained years ago by the reading of inscriptions found at Nineveh; and their discovery by Mr. Taylor is a striking proof of the truth of those interpretations. The main branch of the river, here called Dibeneh Su, is formed by the junction of various small streams, some of these sources being within as short a distance as five miles from other sources which fall the opposite way into the Euphrates. After a course of three miles the principal stream of the Tigris plunges into a lofty cavern, and is lost underground for a distance of two miles, emerging on the south-east, and then continuing its course towards Diarbekr. The numerous masses of rock which now choke the stream near this cavern, and the detached arches, seemed to indicate that the tunnel was formerly of much greater length than it is now. The statement of Strabo with regard to the extremely long underground course of the Tigris near its sources, was therefore, in all probability, not far from the truth.

ROYAL ASTRONOMICAL SOCIETY.—*Jan.* 13.

MR. HUGGINS ON THE OCCULTATION OF THE SPECTRUM OF A FIXED STAR.—The author remarked that while all observations hitherto negative the existence of an atmosphere to the moon, one had occurred to him as not yet made which might add to the evi-

dence on the question. This was the disappearance of the spectrum of a star when occulted by the moon's limb. It appeared to him that if the moon possessed an atmosphere, it should show itself by producing absorption bands, and also by a gradual fading of the spectrum instead of a sudden disappearance. He also thought that, supposing an atmosphere highly charged with aqueous vapour, the red rays would be least affected, and that end of the spectrum would be last to go, while a clear but dense atmosphere would, by refraction, render the blue rays most persistent. He therefore, on the 4th instant, adjusted his spectrum apparatus on the star ε Piscium about three minutes before its occultation. He could not speak positively as to any extra lines being introduced by the moon's contact, the air not being in good condition, but certainly no part of the spectrum disappeared before the other, the obscuration occurring not in the direction of the length of the spectrum, but of its breadth, cutting off all the colours at the same time, and not by a process of fading, but as if an opaque screen had been slowly introduced, about two-tenths of a second being occupied in the occultation. This experiment, therefore, further corroborated the general impression of the absence of any appreciable lunar atmosphere.

PROGRESS OF INVENTION.

Application of Compressed Air to Weaving.—Every one that has witnessed the process of weaving, by means of the power-loom, must have remarked the stunning and most disagreeable noise by which it is accompanied. The greater part of this is due to the mechanism used for throwing the shuttle alternately from one side to the other. In the hand-loom, the shuttle was thrown by the hand of the weaver; in the power-loom, invented in 1785, mechanism more or less resembling the weaver's arm was introduced for the purpose. A great velocity was thus obtained, but an intolerable din was produced, and what was far worse, a deterioration of the textile fabric, consequent on the great vibration communicated to the whole room, and on the irregularity of the motion which is imparted to the shuttle. There is a very great loss of power also, in consequence of the force not being applied in the right direction. Besides all this the mechanism which acts on the shuttle is extremely liable to get out of order: the thread is frequently broken: and it is necessary to use large quantities of oil, which, becoming heated by friction, causes a very disagreeable smell and unwholesome atmosphere, and not unfrequently escaping, injures the cloth. But a great change for the better is now very likely to be introduced. Compressed air has recently been adopted as the means of imparting motion to the shuttle, which may then be made very much lighter. The advantages derived from this arrangement are believed by many to be numerous and considerable. As the force is applied exactly in the direction in which it is required, there is a great saving

of power. As there is no vibration, and the shuttle is thrown with mathematical accuracy, the cloth, even when viewed in the microscope, is found to be entirely free from those irregularities and imperfections which in the ordinary kinds are concealed by the dressing. The atmosphere, instead of being heated and corrupted, is cooled and purified by innumerable jets of fresh air. With the ordinary power-loom, the shuttle is thrown only about 180 times in a minute; with the pneumatic arrangement, it is thrown at least 240 times. This increase of velocity, accompanied by the fact that when condensed air is used the thread almost never breaks, will immensely augment the annual production. Supposing that the half million of looms which are in operation in the United Kingdom were on the pneumatic principle, the increase of production would, on a moderate calculation, be at least a million and a half yards per annum. The new loom has a great advantage over the old, as to first cost and the expense arising from wear and tear. No less than thirty-eight parts hitherto indispensable are got rid of, and friction is greatly lessened in various ways. Oil not being required, there is no danger of the cloth being stained. The fibres, which greatly impede the motion of the shuttle in the old loom, are blown away in the new. The movement of the shuttle is effected in a very simple way. Air is condensed into a reservoir by the steam-engine, and conveyed under the floor in pipes, which communicate with flexible tubes that transmit it to each loom; or the loom itself condenses the air it requires by means of a small air-pump, or even a bellows. A pinion on the main axle of the loom causes the revolution of a wheel, upon which is fixed an inclined stud that acts upon a lever which opens a valve. The latter lets out a jet of air that blows the shuttle forward with great velocity and unerring accuracy. Of course there is a separate valve, lever, etc., for each of the directions in which the shuttle is to be thrown. The superiority of the new loom to others previously invented has, however, been denied.

The Musical Clock of St. Germain l'Auxerrois, at Paris. —This is another very interesting application of compressed air to the simplification of mechanism. All who hear for the first time the musical clocks of Bruges, Mechlin, etc., are charmed with them; but when the same piece, however elaborate it may be, is heard again and again, the admiration cools, until at last, to those who are condemned to listen to it, year after year, from infancy to age, it must become little less than an annoyance. Yet when we consider that each tune played by a musical clock requires a barrel or cylinder, which costs a very large sum—that used in the clock at Bruges cost 60,000 francs—we must readily admit that those who for the credit of their city are desirous of having a musical clock, must make up their minds to the endless repetition of the same piece of music. The mechanician charged with the construction of the clock of St. Germain l'Auxerrois, to which forty bells are attached, appears, however, to have removed this difficulty, since he has lowered the price of the barrel from 60,000 to 250 francs, which makes it possible, without great expense, frequently to change the tune.

The means by which he effects this improvement, are very simple. Hitherto the barrel of a musical clock was required to produce powerful mechanical effects—it had to lift the immense hammers that struck the bells, and therefore it was of necessity large and massively constructed; and to move it enormous weights, and complicated as well as ponderous machinery, were indispensable. With the pneumatic arrangement, the barrel merely opens valves similar to those of a moderate-sized organ, and these allow the escape of air, having a pressure of about two and a-half atmospheres, which gives motion to the mechanism that produces the sounds. The barrel may, therefore, be as moderate in size, and the mechanism attached to it as simple, as that of a self-acting organ. The air is condensed by the gas-engine of Lenoir: but there seems no reason why the condensation should not be effected by some of the enormous water-power that will soon be available in all parts of Paris.

Electro-magnetic Locomotive.—A good deal of excitement exists at present in Paris with reference to an electro-magnetic locomotive which is being exhibited there. It rests on four wheels: those in front are small; those behind—the driving-wheels—are large, and made of copper, and contain each twenty horse-shoe electro magnets arranged in the direction of radii, and having their poles passing through the copper tires so as to be level with the outer circumference. The electric current is produced by a battery which is placed at a station, and is conducted to and from the locomotive by two well-insulated wires, running between the rails. A very ingenious commutator distributes it to the electro-magnets, successively magnetizing and demagnetizing them. The instant one of them is excited, it is attracted by the rail itself, which acts as an armature, or keeper, and the wheel is thus made to revolve, moving the locomotive in one direction, or the opposite, as the case may be. In the present arrangement, the electricity passes from an electro-magnet at one side of the locomotive to one at the other, that is, about one quarter of the circumference in advance. To stop the engine, it is of course only necessary to interrupt the current. This locomotive has one great advantage—it cannot leave the rails, or if it does it will stop immediately. But the power is very trifling, and much of it is lost from the indirect mutual action of the magnet and rail; nevertheless the inventors, MM. Louis Bellet and Charles Rouvre, consider that it would be quite sufficient for the transmission of letters and light parcels, and they even expect it ultimately to supersede the ordinary locomotive. They calculate on a velocity of about 124 miles an hour; and their model does actually attain very considerable speed. But supposing such a locomotive to be, even on the large scale, everything that can be expected, it is still very unlikely that it will compete successfully with the ordinary one. Coal will afford about six times as much power as the same weight of zinc, and, weight for weight, is about forty times as cheap. That is, at the present price of zinc, electro-magnetic is about 180 times as dear as steam-power. To get rid of this difficulty, zinc must become very much cheaper, or a cheap substitute for it must be discovered; neither of which appears sufficiently probable to afford

electro-magnetists much ground for sanguine expectations. In cases, however, in which only small power is required, and the cost of its production is but a secondary consideration, while from the intermittent nature of the work to be done, and other circumstances, a steam-engine would be out of the question, electro-magnetism may be applicable. But, considering the complication and cost of any of the electro-magnetic engines yet invented, it is to be feared that the period at which electro-magnetism will be utilized, even to this limited extent, is still distant.

Pointing of Pins and Needles by Electricity.—The pointing of pins and needles is not only a troublesome, but, notwithstanding all the improvements that have been made, an exceedingly unhealthy operation. The fine metallic dust which is produced enters the lungs, and causes disease, which, sooner or later—generally very soon—proves fatal. There is, however, reason to believe that the old and objectionable process will soon be superseded by a new, a simple, and a harmless one. The latter was supposed to have been recently discovered at Lausanne by M. Canderay, a telegraph engineer; but a correspondent of *Les Mondes*, in the number for December 29, shows that he had published an account of the method so long ago as 1860; he admits, however, that its application to the pointing of pins and needles is a happy and recent idea. The pins, etc., to be pointed are placed close together in a bundle. The latter is to be held perpendicularly, and its upper end having been brought in contact with the positive pole of a Bunsen battery consisting of one or two elements, it is to be immersed in acidulated water contained in a vessel, through the bottom of which the negative pole of the battery has been passed up; the lower end of the bundle and the upper end of the negative pole being kept within a very short distance of each other. In a few minutes, the number being greater or less, according to the nature and concentration of the acid, the nature and thickness of the wires, and the intensity of the current, the ends of the wires next to the negative pole of the battery will have been pointed, the sharpness and form of the points depending on the distance between them and the negative pole. One hundred wires have been pointed in this way, in a few minutes, with a Bunsen battery, consisting of but a single element. Hence, from the smallness of the electric power, and the shortness of the time required, the process promises to be very economical. Sulphuric acid answers best for iron or steel; nitric acid for copper or brass. Our readers can easily make an experiment, illustrating this process by immersing the wire constituting the positive pole of a small battery in dilute acid contained in a glass tube, the lower end of which has been closed with a cork, through which the negative pole of the battery has been passed up. The poles are to be kept for a few minutes very near each other within the fluid.

Simplification of the Common Pump.—A modification of the ordinary suction pump, as it is called, has lately been invented and patented in France, which seems, for many purposes at least, to recommend itself strongly by its simplicity, and other good qualities. The common pump consists, as is well known, of a barrel, a piston,

and two valves opening upwards; the pump to which we direct attention, of only a barrel, a solid plunger, and a single valve. The former pump is exposed to great wear and tear, and very considerable friction, from the necessity for the sucker fitting the barrel exactly; the latter is totally free from these objections. Our readers may make an excellent model of the new pump by fitting water-tight into one end of a cylindrical glass gas chimney a piece of wood or cork, in the centre of which is an aperture, closed within the glass cylinder by a flap of leather, which will act as a simple, but tolerably water-tight valve; and selecting for the plunger a thick rod of wood that nearly fills the cylinder. To work the apparatus, it is only necessary to insert the plunger in the cylinder, fill the space around it with water, and place the closed end of the cylinder in a small quantity of that fluid. When the plunger is drawn up, the valve opens, and water rushes in to supply the vacuum. When the plunger is then pushed in again, the water flows out through the upper end of the cylinder: and thus the process may be continued for any length of time. It is evident that the fluid may be made to issue from a spout or tube, if the upper end of the barrel is enlarged. The principle on which this pump produces its effect is the same as that of the common pump, but it might be supposed that, instead of water rushing up through the valve, water, and even air, would pass down from around the plunger. This, however, is not the case; and it is the most curious circumstance connected with the apparatus. It may be accounted for, however, by the capillary attraction which exists between the plunger and barrel. Experiment alone can show how large such a pump may be made, or from what depth it would cause water to ascend; but there are most probably many purposes for which it would answer well.

New Respiratory Diving Apparatus.—*Cosmos* states that M. Rouquayrol has introduced a reservoir of compressed air, furnished with a mechanism (not explained) for allowing the air to escape in the proportion wanted for submarine respiration. Experiments made in the Napoleon Basin at Rochefort have been successful. The apparatus is also recommended to enable persons to enter a deleterious atmosphere.

Crystal Patterns on Glass and Porcelain.—M. Kuhlmann, continuing his communications to the French Academy on crystallization, gives a process which it would be easy to try on a small scale. If, for example, a solution of sulphate of zinc and a little gum is thickened with chromate of lead, and laid on glass, and the glass heated in a muffle, he obtains a crystalline pattern, shown up in relief by a green tint imparted by the chromic oxyde. Nitrate of potash and nitrate of lead, thickened with gum, and containing powder of coloured enamels, he also finds to afford satisfactory results.

Miscellaneous.—Among the recent improvements in telegraphy, one of the most interesting, perhaps, is the *acoustic telegraph*, in which a note sounded at one place is reproduced at another. It is founded on the fact that a sound is emitted whenever a sufficiently strong electric current is made to begin or

to cease to circulate round an electro magnet; and that a stretched membrane will vibrate in unison with a note produced near it. But, since the same membrane will respond only to certain notes, the range of sounds producible by a single apparatus is more or less circumscribed.——It is proposed to apply to practical purposes the enormous *water power* which will soon be available in Paris, in consequence of the vast waterworks now in progress there, and which, when complete, will raise about 400,000,000 litres a day to the level of the highest houses. The large amount of pressure generated by this will be distributed throughout the city, so as to be easily applicable by means of simple machinery at any given point.——*A steam and air engine* has been recently patented. The cylinder used, like that of Watt's single acting steam-engine, is open at one end. Round the part of it which is near the open end are a great number of holes, which, when the piston has passed them, forms a communication between the interior and the atmosphere, and allows the mixture of steam and air after it has done its work, to escape. At the return stroke of the piston air enters in front of it through these apertures, and is driven into a small chamber at the closed end of the cylinder, where, being mixed with high pressure steam admitted by a valve opened at the proper time by the piston itself, its temperature and therefore its pressure are suddenly raised; and along with the expanding steam associated with it, it drives the piston to the open end of the cylinder. The repetition of these movements causes a reciprocating motion, which is changed into a rotatory, in the usual way. Independently of other objections the heat and pressure acquired by the air are detracted from those of the steam, and what is thus gained in one way, may be found to be so much lost in another.——There is reason to believe that *telegraph wires* may be made to serve a useful purpose, not hitherto contemplated: since it is supposed that they will afford a very effective aid in foretelling changes of weather. It has long been remarked that they are liable to considerable variation in the transmission of the electric currents: but it has been recently observed that when these variations are unusually great they are always followed by bad weather, which is stormy in proportion to the greatness of the irregularities exhibited.——The metal *cæsium* has hitherto been obtained only in very small quantities. To get only seven grains of its chloride Bunsen was obliged to evaporate forty tons of water; and only 0·3 per cent. of it are contained in the Lepidolite of Hebron in the United States. But it has recently been found that the mineral Pollux, which is very abundant in the island of Elba, contains thirty-four per cent. of this metal, which had been previously mistaken for potassium.——*Tellurium* also, hitherto one of the rarest of substances, is found in considerable quantity associated with bismuth, about 15,000 feet above the level of the sea, in one of the loftiest peaks of the Andes.——The reduction of chloride of *aluminium* by means of zinc was patented in 1854, but the principle was not successfully carried out until recently. The vapour of zinc is found to reduce cobalt, nickel, and manganese with great facility.——*Cotton seed oil* may be obtained to the amount of

from fifteen to eighteen per cent. from cotton seed, which is very much cheaper than linseed. The residue is nearly as valuable for fattening purposes as linseed cake. The crude oil answers well for paints and varnishes, and makes excellent soap. The refined is considered little inferior to olive oil.——Two facts of great importance in medicine have lately been discovered. One, that in typhus fever, the interior of the mouth is the seat of a putrid matter that constantly poisons the air passing into the lungs, and becomes the haunt of parasites. Several of the worst symptoms that accompany the disease are now supposed to be due to this. It is removed without difficulty, and to the great benefit of the patient, by very simple means. The other is that the application of phenic acid in the dressing of putrid sores not only prevents or removes the offensive odour, and stops disorganization with great rapidity, but leads to a speedy and healthful healing, even in the very worst cases. It is applicable not only externally, but, notwithstanding its caustic properties, internally also; and it appears to be specially useful in cases of an infectious nature.——It has been found that *pencil drawings* may be reproduced in any number, with great facility. For this purpose they are to be moistened with dilute acid, and then inked with a roller. Only the pencil marks will take the ink, and the drawing may then be transferred to metal or stone, in the usual way, by pressure.

NOTES AND MEMORANDA.

Apparent Diameter of Sirius.—Sir Wm. Herschel endeavoured to find the apparent diameter of Sirius as seen in a telescope, and freed from the enlargement due to optical defects. He estimated it at the tenth of a second. M. Chacornac, availing himself of more recent apparatus, views the star through what he calls a "prismatic telescope," and which the secretary of the Astronomical Society supposes to mean "a double-image prismatic micrometer eyepiece." M. Chacornac's letter, which appears in the *Monthly Notices*, does not explain his method with sufficient distinctness. The society's hon. secretary (Mr. Pritchard) points out that in the spurious discs of stars, as seen through telescopes, the light diminishes from the centre to the circumference of the principal image, and varies in a similar manner through the series of rings with which the star image is surrounded. He supposes M. Chacornac to form two images of the spurious disc by means of double refraction, polarized in planes at right angles to each other. When the prisms are rotated, the ordinary image is unaffected, but the extraordinary image suffers gradual extinction, the weaker parts, or margins, being extinguished first, and the centre last. If the star exhibited a true disc in the telescope, it would remain, and be susceptible of measurement after the spurious light surrounding it had been extinguished. When, however, the spurious light is cut off, M. Chacornac found, with Foucault's great telescope, that only an imperceptible point remained, so that the apparent diameter of Sirius, freed from appendages resulting from the intensity of his light, resembled the apparent diameter of a twelfth-magnitude star.

Biela's Comet.—In a communication to the *Astron. Nach.*, Dr. Giacomo Michez expresses a hope that when this body, which revisits us this year, approaches its perihelion in the beginning of 1866, decisive evidence may be obtained concerning the two nuclei which were seen in 1852. In 1859 the feebleness of the comet's light, and its immersion in strong twilight, precluded obser-

vation. We do not publish the positions of the comet between July, 1865, and March, 1866, as given by Dr. Michez, as it will be better to do so at a later period. We may, however, say, for the benefit of distant subscribers, that on July 24 the R.A. will be 0h. 18m. 37s., D. + 18° 40′ S.

EARTHQUAKE AT FLORENCE.—M. P. de Tchihatchef describes to the French Academy an earthquake felt at Florence and its vicinity on the 11th December last. The observations of Prof. Donati show that the centre of the disturbance was at Fierenzuola, a village forty-five kilometres, or rather more than twenty-seven miles from Florence. This convulsion is remarkable, not only because earthquakes are rarely felt at Florence, but because it is the first time volcanic action has been manifested in the limestone (*massif calcaire*) of the Appennines situated north of the city. The occasional concussions previously felt at Florence have come from the Pontifical States, which lie in an opposite direction.

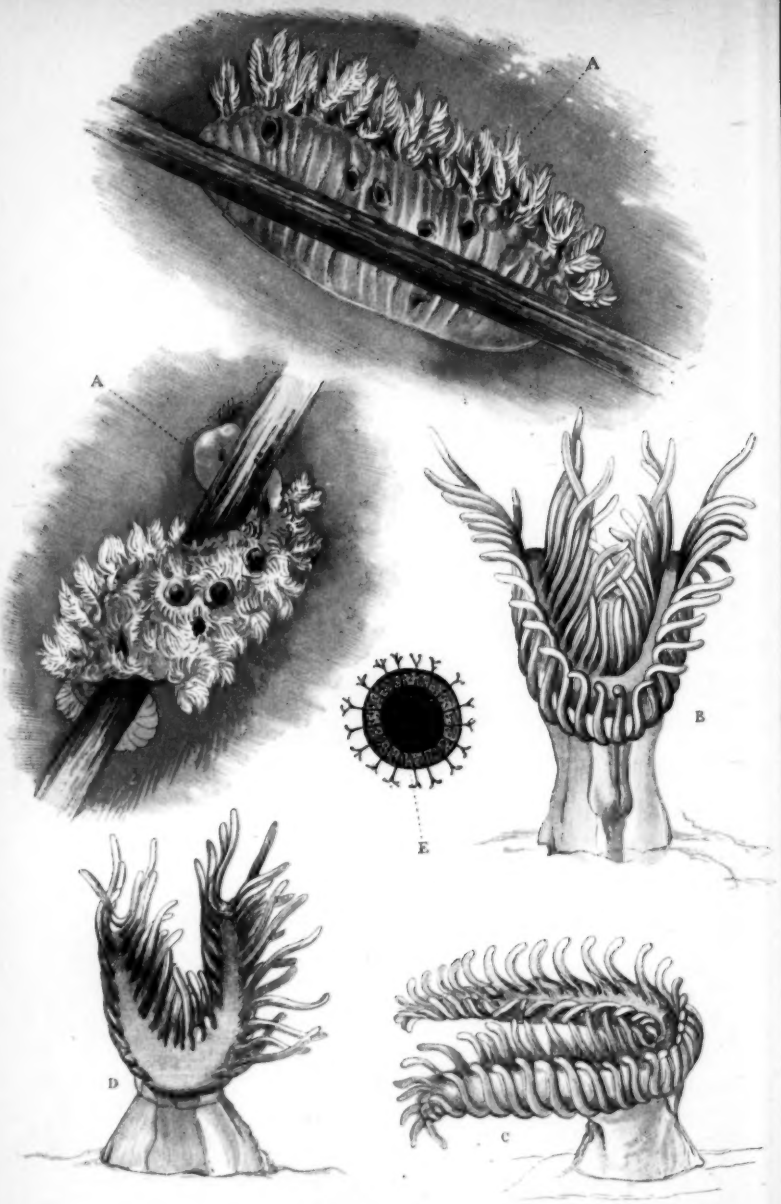
CARDBOARD CELLS FOR MOUNTING MICROSCOPIC OBJECTS.—At a recent meeting of the Microscopical Society, Mr. Henry Lee exhibited specimens of cells cut from tubes of cardboard, which, being very cheap and easily made, will be found exceedingly useful in the mounting of dry and opaque objects. They are constructed in the same manner as the sides of pill-boxes, by rolling gummed paper on a wooden mandril, and cutting rings from the tubes thus formed when dry and hard. It will be seen that they can readily be made of any required depth, diameter, or thickness.

BROWNING'S SPECTROSCOPE BURNER.—Mr. Browning has introduced a convenient Bunsen burner, mounted so as to slide up and down a rod for adjustment of height. The same rod carries a moveable holder for a piece of platina wire, or anything else which it is desirable to introduce into the flame.

ANTIPATHIES OF DOGS.—A brown retriever known to the Editor, very good-tempered to most people, and very quarrelsome with most dogs, recently exhibited decided symptoms of anger when patted by a gentelman he usually made friends with. The dog's master suggested that it was probably because the visitor had been caressing his own dog with the same hand. To test this, the other hand, to which the objection could not apply, was tried, and the retriever immediately manifested his accustomed pleasure at being noticed.

NEW ELECTRO MAGNET.—M. de Moncel has described to the French Academy a new electro magnet devised by M. Carlier, and reported to possess great power. He does not employ covered wire for his spirals, and the statement says the only condition is that the different spiral layers shall be separated from each other by envelopes of paper, and that the bobbins shall be of wood or copper, covered internally with an insulating substance. An electro magnet of this construction, having iron cores 4½ centimetres long (nearly 1·8 inches), and 7 millimetres wide (rather more than ¼ inch), with one spiral composed of wire, 0^{mm}·277 diameter,* making 103 turns, supported 3·900 kilogrammes, or more than 8 lbs.

* The millimetre is 0.039 inch. Our readers will find "Dowling's Metric Tables" very useful to solve these questions.



THE WANDERING POLYZOON.
Cristatella Mucedo.